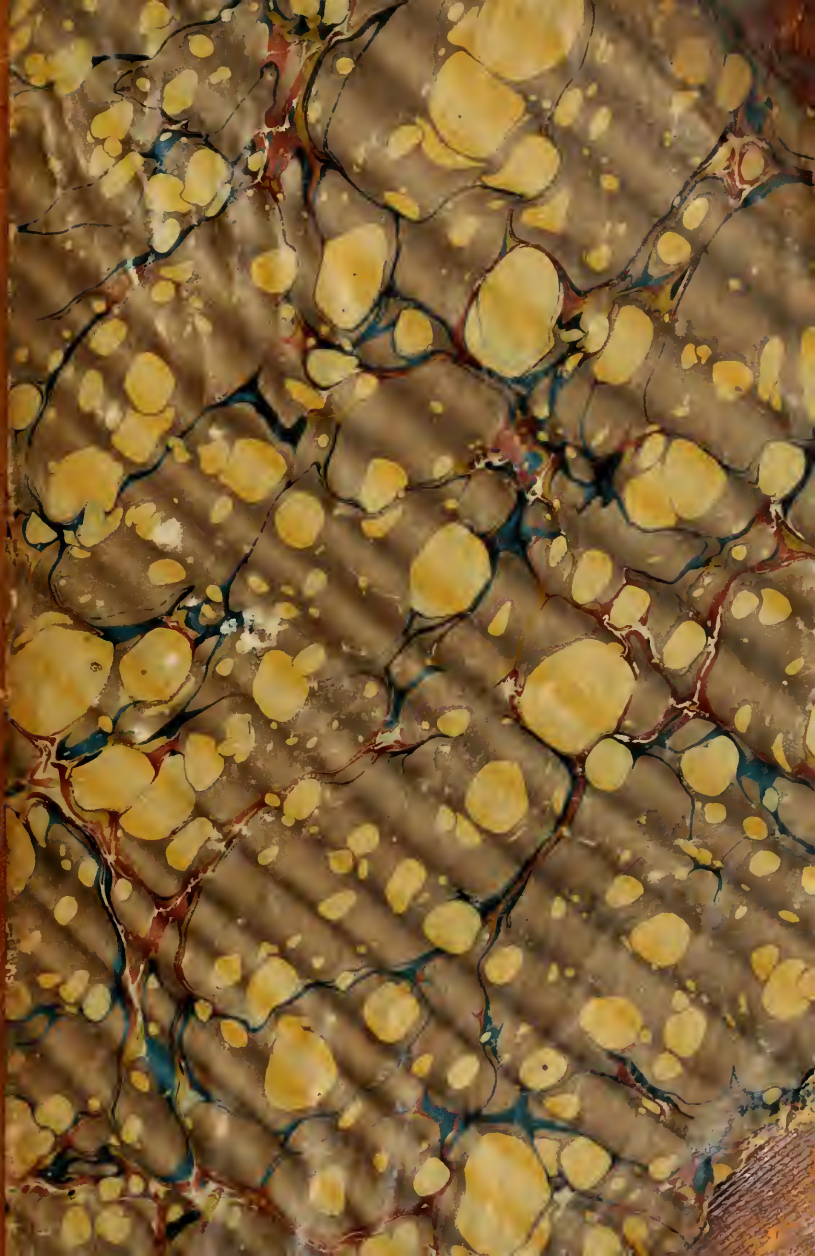

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ON THE

METHODS OF ANALYSIS

AND THE

COMPOSITION OF VARIOUS CHEMICAL MANUFACTURING PRODUCTS.

BY M. GASTON TISSANDIER.

(Continued from Am. Repr., Oct., 1869, page 211.)

Sulphates of Potash.

Almost all commercial sulphates of potash are obtained from beet-root salts, or by treating the ashes of sea-weed. All specimens, whatever their origin, may, however, be analysed in the following manner.

Mode of Analysis.—Weigh 25 grms. of the sulphate in question, and dissolve in distilled water; filter, to separate the insoluble substances, and wash the filter until the clear liquid, collected in a graduated measure, occupies the volume of 500 c.c.

Alkalimetric or Acidimetric Standard.—Plunge sensitive litmus paper into the solution, and ascertain whether it be alkaline or acid. In the first case, take the alkalimetric standard in 100 c.c. In the second, which is less frequent, obtain the acidimetric standard by means of a standard potash solution.

Sulphuric Acid.—The sulphuric acid is estimated in 10 c.c. of the solution (0·5 grm.), by means of chloride of barium.

Chlorine.—Determine the proportion of chlorine in 50 c.c. (2·5 grms.) by standard nitrate of silver.

Potassium.—To estimate this exactly, add to 10 c.c. of the solution a few drops of chlorhydric acid and of a standard solution of chloride of strontium, in such quantity that all the contained sulphuric acid may be precipitated in the state of sulphate of strontia. Let it stand for twelve hours; filter, and, after washing the precipitate, evaporate the filtered liquid almost to dryness. Add a slight excess of bichloride of platinum, and evaporate with the precipitated chloroplatinate of potash, which must be collected and weighed, as directed under the article "Salts."* The transformation of the sulphate into chloride by the chloride of strontium is indispensable, if an exact result be desired. Were the bichloride of platinum added directly to the solution of the sulphate, the potash would not be entirely precipitated; the precipitated chloroplatinate would contain, as has been already proved, a certain proportion of non-decomposed sulphate.

Moisture.—The salt is dried on a stove, at 110°, or in a platinum crucible.

Calculation of the Analysis.—The potassium found is converted into sulphate of potash, and it is seen by calculation if the quantity of sulphate of potash so formed contains the proportion of sulphuric acid found. If there is an excess of sulphuric acid, it is converted into sulphate of soda. If, on the other hand, the quantity of potassium is too considerable to saturate the whole of the sulphuric acid, the excess must be combined with chlorine and carbonic acid. Some sulphates contain chlorhydric acid. Its presence may be accounted for by the addition of sulphuric acid in the manufacture. The sulphuric acid is used to transform the carbonate of potash into sulphate, but, if added in too great excess, it will act upon the chloride of potassium, and give rise to an equivalent quantity of chlorhydric acid.

Composition of Commercial Sulphates.

I. *Sulphates obtained from Beet-root Salts.*

Matters estimated.	I	II.	III.	IV.	V.
Moisture	5·61	4·47	1·99	1·61	3·11
Insoluble matter	0·22	0·41	1·18	0·42	0·16
Chloride of potassium	2·77	1·72	1·61	1·68	1·20
Sulphate of potash	85·80	91·08	92·50	93·79	91·20
Carbonate of potash	3·00	2·60	2·72	2·41	4·11
Carbonate of soda	2·60	—	—	—	—
Non-estimated and loss	—	0·20	—	0·09	0·22
Total	100·00	100·00	100·00	100·00	100·00
			M. A. Lefebvre, Corbehem, near Douai.		M. Dronlers, Aseq, nr. Lille.

II. *Sulphates obtained in the Manufacture of Iodine.*

Matters estimated.	I.	II.	III.	IV.	V.
Moisture	3·99	2·02	1·22	4·21	1·01
Insoluble matter	0·29	0·20	0·10	0·19	0·12
Chloride of sodium	7·12	8·72	1·32	1·66	5·80
Sulphate of potash	75·84	75·12	75·62	77·00	82·69
Sulphate of soda	11·45	12·81	21·12	16·22	9·35
Carbonate of soda	0·80	0·71	0·62	0·72	1·03
Non-estimated and loss	0·51	0·42	—	—	—
Total	100·00	100·00	100·00	100·00	100·00

Caustic Soda.

Specimens of commercial caustic soda generally present the appearance of greenish or yellowish masses, which must be quickly crushed into small fragments before analysis. For this purpose, it is best to employ a cast-iron mortar, perfectly clean, and previously warmed, in order that the soda may not absorb atmospheric moisture in any appreciable quantity during the crushing. Commercial caustic sodas always contain chloride of sodium, sulphate and carbonate of soda. The method by which the exact proportion of these constituent elements may be ascertained will now be shown.

Total Alkalimetric Standard.—Weigh 5 grms. of caustic soda quickly, and dissolve them in water. Take the alkalimetric standard in the cold, by means of ordinary standard sulphuric acid. The total standard of caustic soda sometimes from 108 to 110°.

* Chemical News, vol. xx., p. 73 (*Am. Repr., Oct.* 1869, *p.* 207).

Estimation of Caustic Soda.—Weigh 5 grms. of caustic soda, and throw them into a stoppered flask containing about 400 c.c. of water: distilled water, previously boiled, to avoid its containing carbonic acid, is the best. When the soda has been dissolved by stirring, add an excess of chloride of barium, which will precipitate the sulphate of soda as sulphate of baryta, and the carbonate of soda as carbonate of baryta. The liquid thus formed must be filtered, care being taken to close the flask as much as possible, and to cover the top of the filtering funnel with a plate of glass, to avoid the action of the air. It is especially needful to place the funnel in a flat-bottomed flask, that the filtered liquid may not come in contact with the ambient air. Litmus is added to the filtered liquid, and the alkalimetric standard taken in the cold. The addition of normal sulphuric acid solution causes the formation of a precipitate of sulphate of baryta, due to the excess of chloride of barium; but this occurrence is of no importance. The number of divisions on the burette must be read at the exact moment when the last drop of standard liquid causes the solution to change from violet-blue to vinous-red. This number gives the standard of causticity, which, again, shows, by calculation, the quantity of caustic soda according to the following equation:—

$$\frac{\text{Standard or number of divisions on the burette}}{x} = \frac{49(SO^3,HO)}{40(NaO,HO)}$$

The standard of causticity obtained, deducted from the total standard, gives the standard corresponding to the carbonate of soda, and, consequently, the proportion of the latter salt. To be more exact, this determination should be verified in the following manner.

Carbonate of Soda.—The filter containing the sulphate and carbonate of baryta will also serve to determine the quantity of carbonate of soda. Pour upon the filter water acidulated with pure chlorhydric acid, which will dissolve only the carbonate of baryta, without acting at all upon the sulphate. The filtered liquid contains, in the state of chloride of barium, all the baryta of the carbonate of baryta. Sulphuric acid is now added, and, after standing for twelve hours, the precipitated sulphate of baryta is weighed. The sulphate of baryta is transformed, by calculation, into carbonate of baryta, or, directly, by equivalents, into carbonate of soda; and thus the quantity of the latter salt contained in 5 grms. of caustic soda is ascertained.

Sulphate of Soda.—The amount of sulphuric acid in caustic soda is estimated in 5 grms. of the specimen under analysis, by means of chloride of barium (see article, "Salts," *ante*). If it be desired to omit this experiment, the filter used to obtain the standard of causticity may be immediately weighed, after rinsing with chlorhydric acid, to remove the carbonate of baryta. In this case, in order that the estimation may be exact, the precipitate of carbonate and sulphate of baryta must be allowed to stand for twelve hours.

Chloride of Sodium.—Weigh 2·5 grms. of caustic soda, and throw into a stoppered flask; dissolve it in water, acidulate with pure nitric acid, and estimate the chlorine with the standard nitrate of silver liquid see article, "Salts," *ante*).

Moisture.—The moisture contained in caustic soda is estimated by operating in a silver crucible, which must have a cover. It is weighed empty, and again weighed with a small quantity of caustic soda. Heat is carefully applied to fuse the soda: great precaution must be used that the temperature may not be too much increased, in order to avoid projections. The action of too much heat would not only remove the moisture, but also part of the water in combination with the caustic soda, and the erroneous figure thus obtained would be, in that case, much too high. The caustic soda, once fused, is again weighed, and the three weights thus obtained are the bases of a simple calculation, which will give the quantity of humidity contained.

Calculation of the Analysis.—Some of our readers have asked for more ample details respecting the calculations necessitated by these modes of analysis. We will, therefore, re-produce an example of the analysis of caustic soda.

Direct Results of an Analysis of Caustic Soda.

Total standard, 109°.

Standard of causticity, 106°.

Number of divisions of the graduated burette of nitrate of silver (estimation made on 2·5 grms.), 101 divisions.

Weight of the sulphate of baryta in 5 grms., 0·195 grm.

By deducting the standard of causticity from the total standard, the standard of carbonate of soda is obtained. Say, $109 - 106 = 3$. To obtain the quantity of carbonate of soda corresponding to a standard of 3 degrees, it is only necessary to state the following equation:—

$$\frac{3}{x} = \frac{49(SO_3HO)}{53(CO_2NaO)}$$

Whence x (carbonate of soda) = 3·44 per cent.

The standard corresponding to the caustic soda is 106°. Consequently,

$$\frac{106}{x} = \frac{49(SO_3,HO)}{40(NaO,HO)}$$

will give x (hydrated caustic soda) = 86·53 per cent.

Commercial caustic soda is generally sold according to the quantity of anhydrous soda, NaO. To obtain NaO, state the equation—

$$\frac{86{\cdot}53}{x} = \frac{40(NaO,HO)}{31(NaO)}$$

Whence x (NaO) = 67·306 per cent.

For the chloride of sodium, the standard liquid containing nitrate of silver in such a quantity that one division corresponds to 1 milligramme of chlorine, state the equation—

$$\frac{101}{x} = \frac{35{\cdot}5(Cl)}{58{\cdot}5(NaCl)}$$

Whence $x = 1{\cdot}66$. But 2·5 grms. were operated upon; it is, therefore, necessary to multiply by 40 to obtain the quantity of chloride of sodium in hundredths.

$$1{\cdot}66 \times 40 = 6{\cdot}64, \text{ or } ClNa = 6{\cdot}64 \text{ per 100.}$$

The sulphate of baryta, in 5 grms., weighs 0·195 grms. Consequently, the equation—

$$\frac{0{\cdot}195}{x} = \frac{116{\cdot}5(SO_3BaO)}{71(SO_3,NaO)}$$

will give $x = 0{\cdot}118 \times 20 = 2{\cdot}36$ of SO_3NaO per cent.

The analysis is thus formularised, after estimating the moisture, which we will suppose to exist in the specimen under analysis in the proportion of 1·02 per cent.

[English Edition, Vol. XX., No. 519, pages 217, 218.]

Moisture	1·02
Chloride of sodium	6·64
Sulphate of soda	2·37
Hydrated caustic soda	86·53
Carbonate of soda	3·44
	100·00

Oxide of sodium (NaO) = 67·306 per cent. We have omitted the calculation relative to the determination of the carbonate of soda by the carbonate of baryta, as it is sometimes unnecessary. Supposing the above analysis to have been scrupulously exact, the carbonate of baryta dissolved in pure chlorhydric acid, and precipitated as sulphate of baryta, would yield a weight of 0·379 of sulphate of baryta.

$$\frac{0{\cdot}379}{x} = \frac{116{\cdot}5(SO_3BaO)}{53(CO_2NaO)}$$

would give $x = 0{\cdot}172$ as the quantity of carbonate of soda contained in 5 grms. Multiplying by 20, the product would be—Carbonate of soda = 3·44 per 100.

Composition of Caustic Sodas.

Matter estimated.	I.	II.	III.	IV.	V.	VI.
Moisture	4·38	3·31	3·71	0·59	0·68	1·11
Chloride of sodium	11·32	12·22	3·90	7·23	6·89	5·60
Sulphate of soda	3·41	2·00	2·60	1·00	1·32	2·10
Carbonate of soda	5·58	9·82	3·69	3·45	3·68	5·48
Caustic soda (NaO,HO)	75·21	72·65	86·10	87·73	87·50	85·71
Total	100·00	100·00	100·00	100·00	100·00	100·00
Oxide of sodium (NaO) p. 100.	58·10	56·30	66·67	68·00	67·80	66·42
	French sodas.			English sodas.		

Sodas of a much poorer quality than those whose composition we have just given are occasionally to be met with. We subjoin an example of the analysis of one of these poorer caustic sodas. Caustic sodas are generally sold according to the quantity of anhydrous oxide of sodium (NaO); and the analyses are usually formularised in the above manner. It will be seen from the above figures that the products of English manufacture are much richer than the French. Some few French manufactures have already brought the production of caustic soda to perfection; but much progress still remains to be realised in France with respect to this manufacture.

Composition of Very Poor Caustic Soda.

Matter estimated.	I.	II.	III.
Moisture	1·01	0·92	0·99
Chloride of sodium	18·86	19·76	17·47
Sulphate of soda	7·42	3·09	2·36
Carbonate of soda	6·48	34·63	38·37
Hydrated caustic soda	66·12	41·60	40·81
Total	100·00	100·00	100·00
Oxide of sodium (NaO) per 100.	51·24	32·24	31·60

Salts of Soda.

Commercial salts, or carbonates of soda, are divided into hydrated salts and dry, or anhydrous salts. In most cases, the determination of the alkalimetric standard suffices to show the value of the product. The method of preparing the standard liquid sulphuric acid, which is very important, is as follows:—

Alkalimetric Standard Liquid.—The method which I prefer, and which may be called *méthode des tatonnements*, is as follows:—

Take pure commercial sulphuric acid, and weigh rather more than 100 grms. to the litre, in order to compensate for the proportion of water which is always contained in it. Let us suppose that 10 litres of standard liquid are required; a large bottle must first be gauged, by weighing into it 10 litres of distilled water, and marking the line made by the upper surface of the liquid with a stroke of a file. This done, half the water is poured away, and, to what remains, 1·200 grms. of pure commercial sulphuric acid are gradually added; the 10 litres are then filled up with distilled water. The liquid must now be stirred; and if the acid is of a good quality, the real composition of the normal liquid will be nearly arrived at, for the 200 grms. previously weighed will approximatively compensate the excess of water contained in the acid. The liquid will contain about 100 grms. of SO_3,HO per litre; but a mere approximation will not suffice, as extreme exactitude is indispensable. This first liquid must, therefore, be tested, in order to see whether it is too concentrated or too weak; that is, whether water or sulphuric acid must be added.

The test is easily effected with dry and pure carbonate of soda, which should estimate 92·40°, if the liquid is quite correct. It is a good plan to prepare the carbonate of soda one's self, in the following manner:—Fill, with bicarbonate of soda, a funnel, the lower part of which is provided with a plug of amianthus; wash the salt with water, so as to purify it and to eliminate the alkaline sulphates and chlorides with which it is mixed. When the rinsing-water no longer contains either chlorine or sulphuric acid, the bicarbonate of soda is pure; it must then be crystallised and calcined, when carbonate of soda is produced. To obtain still more exactitude, this is again dissolved, crystallised, and calcined, and it will then be perfectly pure and dry, and should estimate 92·40°.

In testing the alkalimetric liquid, it is a good plan to heat the carbonate of soda before weighing, and even to calcine it slightly, in order to separate the water which it may have absorbed; 5 grms. are then weighed, and their standard taken. If this proves to be too high—say, for instance, 94°—the liquid is too weak, and a small quantity of sulphuric acid must be added. By thus feeling the way, as it were, adding now more acid and now more water, a liquid is easily obtained which will give, in combination with the dry, pure carbonate of soda, a normal standard of 92·40°.

In order to avoid error, it is indispensable that the alkalimetric burettes employed should be scrupulously exact; they should, therefore, be tried—the best way of doing this is by means of the balance. A small precipitating vessel should be tared upon the pan of a sensitive balance, and distilled water poured into it from a burette. If the burette is correct, the volume of water contained between ten divisions, or 5 c.c., must be 5 grms.

Still greater exactitude may be obtained by testing the standard acid with protoxide of lead as follows:—Weigh 20 grs. of pure litharge, and heat them, in a small capsule, on a Gay-Lussac stove at 110°, until their weight no longer decreases; pour in 10 c.c. of the alkalimetric standard liquid, which, if correct, should contain 1 decigrm. of sulphuric acid, SO_3,HO; evaporate the whole to dryness on the stove, and weigh again. The increase of weight should be exactly 0·0816 grs., corresponding to the quantity of SO_3 contained in 0·1 gr. of SO_3,HO.

Too many precautions cannot be used in order

to obtain a well-prepared normal liquid, which is of the utmost importance in working analyses. Some chemists are in the habit of estimating the sulphuric acid contained in 5 c.c. of the liquid; for this purpose, chloride of barium is used; and a well-performed experiment on a correct liquid should yield 0·2378 of sulphate of baryta, corresponding to 0·1 gr. of SO_3,HO.

Analysis of Dry Soda-Salts.—We will say nothing concerning hydrated carbonates of soda, which often contain more than 60 per cent of water; it is only necessary to remark that the alkalimetric standard is very important, as it often exposes the fraud of dealers. The method which we are about to describe, for analysing dry salts of soda, may also be applied to hydrated salts.

Weigh 25 grms. of the salt to be tested, dissolve in water, and filter the insoluble substances upon a filter placed above a test-glass gauged to ½ a litre. The liquid ½ litre is divided in the following manner:—

Remove 100 c.c., corresponding to 5 grms., to ascertain the alkalimetrical standard. By stating the equation—

$$\text{Standard, or number of divisions on the burette} = \frac{49(SO_3HO)}{53(CO_2NaO)}$$

the carbonate of soda per cent is obtained. Deduct 50 c.c., to estimate the chlorine, which is transformed into chloride of sodium, and 100 c.c., to estimate the sulphuric acid, which is changed into sulphate of soda. The estimation of the moisture is effected separately in a platinum crucible. Those who wish for a description of the process are referred to former chapters.

Composition of Salts of Soda.

Substances estimated.	I.	II.	III.	IV.	V.
Moisture	2·22	3·11	1·15	1·00	0·40
Insoluble matter	0·12	0·22	0·08	—	0·06
Chloride of sodium	12·48	6·41	3·28	2·11	0·99
Sulphate of soda	8·51	3·25	2·15	1·50	0·35
Carbonate of soda	76·67	87·01	92·34	95·39	98·20
Total	100·00	100·00	100·00	100·00	100·00

Salts of soda derived from the refining of beet-root salts always contain a small quantity of potash, which may be easily estimated by means of bichloride of platinum.

Estimation of Caustic-Soda.—Salts of soda sometimes contain caustic soda, the proportion of which may be determined in the following way:—

Pulverise part of the specimen finely, throw it into a stoppered flask, into which have been previously poured 100 c.c. of alcohol at a temperature of 40°, and stir vigorously for 10 minutes. The alcohol does not dissolve the soda, while at the same time it absorbs the whole of the caustic soda. Filter under a bell-glass, in order to avoid evaporation of the alcohol; collect 50 c.c. of the liquid, which will correspond to 5 grms. of salt, saturate it with the alkalimetric liquid in the cold, adding water and a few drops of sensitive litmus, and the *standard of causticity* will be obtained. This standard allows the calculation of the corresponding quantity of caustic soda, NaO,HO, deducted from the total standard; the difference given will be the standard corresponding to the carbonate of soda.

Composition of Salts of Soda containing Caustic Soda.

Substances estimated.	I.	II.	III.	IV.
Moisture	2·10	1·50	2·48	1·38
Insoluble matter	0·12	0·11	0·21	0·09
Chloride of sodium	4·32	2·43	3·50	4·11
Sulphate of soda	8·88	1·62	2·15	2·50
Carbonate of soda	82·47	88·09	84·54	81·67
Caustic soda	2·11	6·25	7·12	10·25
	100·00	100·00	100·00	100·00

Detection of Iron and Sulphides.—Salts of soda destined for the manufacture of glass should be free from iron (which colours the glass), and from alkaline sulphides. Iron may be detected by means of sulphydrate of ammonia, or, which is better, sulphocyanide of potassium, the most sensitive reagent of that metal. If the solution of the salt under examination should contain traces of iron, it will assume a red hue under the influence of some drops of this reagent poured into an acidified liquid. To detect sulphides, boil the salt of soda to be tested in a flask containing sulphuric acid diluted with water. The liberated sulphydric acid may be known by its smell, or by the influence which it exerts upon paper previously soaked in acetate of lead.

Nitrates of Soda.

The analysis of nitrates of soda requires great care; for the amount of nitrate contained in them is determined by difference.

Estimation of Moisture.—Heat 5 grms. of the specimen on the stove at 120° until they no longer lose weight. The method of the closed tube, previously described, may also be employed.

Estimation of Chlorine.—Nitrates of soda do not usually contain more than from 1 to 1·60 per cent of chloride of sodium, therefore the estimation must be made upon 10 grms. with the silver liquid.

Estimation of Insoluble Substances.—Dissolve 25 grms. of nitrate of soda in water, and separate the insoluble matters by filtration. They, however, occur in but small proportions.

Estimation of Sulphuric Acid.—This is estimated on 25 grms. of nitrate of soda. The filtered liquid is now used for this purpose, having previously served to determine the quantity of insoluble substances. The sulphuric acid is precipitated as sulphate of baryta, and filtered after standing twelve hours.

Subjoined is an example of the composition of some commercial nitrates of soda, and of the way in which it is usual to formularise the analytical results obtained.

Loss per cent.	I.	II.	III.	IV.
Moisture	0·98	1·11	1.42	1·68
Insoluble matters	0·07	0·12	0·16	0·15
Chloride of sodium	0·99	1·10	1·41	1·60
Sulphate of soda	0·18	0·20	0·22	0·25
Total loss	2·22	2·53	3·21	3·68
Nitrate of soda	97·78	97·47	96·79	96·32
Total	100·00	100·00	100·00	100·00

The quantity of water contained in nitrates of soda rarely exceeds from 2 to 2·50 per cent. The proportion of nitrate of soda varies between 95 and 99 per cent.

(To be continued.)

[English Edition, Vol. XX., No. 520, pages 230, 231.]

ON MICROSCOPICAL MANIPULATION.*

BY W. T. SUFFOLK, F.R.M.S.

(Continued from Am. Repr., Dec., 186), p. 331).

The microscopist, in the course of his studies, will find a very large class of substances for which the processes described in the preceding chapter are of no avail, owing to the impossibility of drying them without materially affecting their structure. The preservation of such substances has always been a matter of some trouble; and beginners are frequently deterred from attempting the processes of fluid mounting by supposing that the difficulties are of an insurmountable kind.

There is also a prejudice against objects mounted in fluid, owing to their supposed want of durability. There is, no doubt, some ground for this objection if the ordinary fluid-mounted objects only are considered. These are of necessity manufactured cheaply and in large numbers, and but little care can be bestowed upon their preparation. But, if the cabinets of our best manipulators are examined, the evidence will be found rather in favour of than against fluid mounting, provided care be taken to adopt the best processes, and carry them out carefully; the causes of failure being rather attributable to bad workmanship than to defects in the mode of preparation. Instances are on record of objects mounted in fluid as long ago as twenty years being still in good preservation.

The subject naturally divides itself into two parts; the processes connected with the enclosing of the object in its cell, and the consideration of the nature of the fluid media employed as preservatives.

The object to be mounted in fluid will nearly always require some previous preparation, excepting in those cases where it is free from included air, and the fluids contained in its tissues are readily miscible with the preservative employed. This preparation consists in keeping the tissues required for preservation immersed either in the fluid in which they are to be mounted, or some other which is capable of combining with it without injurious chemical change. This soaking will occasionally occupy a considerable time; but it may be materially expedited by making use of the air-pump, which will ensure the saturation of the tissue, and assist in the removal of air that may be held within it. The process is exactly the same as that adopted on the large scale for the preservation of railway-sleepers, by impregnating them with creosote; and, in another operation (one that more closely approaches the subject under consideration), Manfield's patent for making pickles, in which the vegetables to be treated are saturated in a few minutes with vinegar, by being submitted to its action in a vessel from which the air has been exhausted; a process which took so long a time in the ordinary way, that manufacturers, to save the loss of capital involved in using vinegar, employed brine, which was afterwards removed by strong acetic acid, greatly to the detriment of the resulting manufacture, both as to flavour and wholesomeness. This is now obviated by the new process, the pickles produced by which closely resemble those made at home.

Although the air-pump is useful where substances peculiarly liable to retain air (such as large anatomical preparations) are being operated upon, its use can generally be dispensed with for ordinary purposes, a prolonged soaking being sufficient in most cases.

In mounting an object in fluid, a cell of suitable size and depth is to be selected, and care taken that it is properly cleaned. It is then filled with the mounting fluid, and should be rather over than under filled. The object is now placed in the cell, unless circumstances have rendered it advisable that this should be done previously. The preparation, at this stage, should be carefully examined, with a view to the detection of air-bubbles. They are especially liable to adhere to the lower part of the cell, where it joins the glass slide. They are best dislodged by drawing the point of a needle round the interior of the cell. Floating bubbles may be broken or removed by lightly touching with a pointed fragment of blotting-paper.

The cover glass is to be placed upon the cell as directed in balsam mounting—letting one edge touch the cell first; and, as in that process care was taken to keep everything dry, in fluid mounting we should adopt the opposite course of treatment. To secure the adhesion of the mounting fluid to the cover, and lessen the chance of including an air-bubble, it is well to moisten the cover by breathing on it just before placing it on the cell.

The surplus fluid is best removed, in the first instance, by drawing it off with a curved and sharp-pointed pipette, made in the form of an ordinary blow-pipe. The use of this contrivance will generally allow the floating cover to be brought in contact with the top of the cell without the risk of flooding its upper surface, which is nearly sure to take place when the cover is pressed down suddenly, and will give trouble to remove when viscid fluids like glycerine and oil are used. When as much of the fluid is removed as can be conveniently taken up with the pipette, the rest is absorbed by the careful use of fragments of blotting-paper. Care must be taken not to carry this process too far, as, if too much of the fluid is absorbed, an air-bubble may enter, which will necessitate the removal of the cover and a repetition of the operation. The moisture being cleaned off the outside, the cell is ready to receive its first coat of varnish, which is to be applied with a small brush, and care should be taken to fill the angle at the contact of the cover and cell, and to include in the ring of varnish a small portion of the edge of the cover. This first coat of varnish must be put on by hand, as the adhesion of the cover is too slight to bear the action of the turn-table, which machine, however, may be employed with advantage in laying on the second and subsequent coats, as, by its use, greater neatness and rapidity are attained than are possible by painting on the varnish by hand.

The best and most durable cement for securing the covers of objects mounted in fluid is the varnish known as japan gold-size, the principal constituent of which is boiled linseed-oil. It is easily obtained at any varnish shop. It is best kept for use in the collapsible tubes recommended for holding Canada balsam. If kept in a bottle, it absorbs air, thickens, and loses, to some extent, its drying properties. This varnish is remarkable for its elasticity and toughness when dry, which may readily be proved by scraping a portion, which will be found to come away in shreds instead of chipping, as many other varnishes do. Glycerine and castor-oil, both valuable mounting fluids, have the unfortunate property of dissolving gold-size; therefore, in using these media, it is necessary, before putting on the coatings of gold-size, to apply two or three coatings of

* The substance of a course of lectures delivered to the members of the Quekett Microscopical Club, January—April, 1869.

the liquid glue previously mentioned. This varnish is impervious to oil and glycerine, but is too brittle when dry to be trusted alone. The liquid glue will be found effectually to protect the gold-size, with which the preparation is to be finished. This precaution is not required when using media which do not injuriously affect gold-size, such as weak alcohol and water, saline solutions, camphor and creosote water, &c.

Some microscopists make use of asphalte or Brunswick black for securing the cover. They have the fault of being brittle, which, however, is said by Dr. Beale to be remedied by the admixture of a small portion of solution of india-rubber in naphtha. The author's experience of this cement is rather unfavourable. It may, however, be owing to having used a bad specimen; as it is probable that many kinds of Brunswick black are manufactured, and they are likely to vary extremely in quality. However, as gold-size is so reliable a cement, and so easily procured, there is no occasion to risk the use of a varnish whose properties are somewhat uncertain.

Should the mounting fluid be one which leaves a deposit on drying (which is the case with saline solutions), or be difficult to clean off (like glycerine), after the first coat of varnish is dry, the slide should be washed, either by holding under a partially-open tap, or by means of the ordinary wash-bottle. If this precaution is not taken, the adhesion of the cement is rendered uncertain, and neglect of this matter is a not unfrequent cause of leakage. If necessary, this washing must be repeated after the second coat of varnish. With oil, a somewhat different treatment is needed. The cleaning is best effected with a camels'-hair brush, charged with turpentine or benzol.

The slide should not be put away in the cabinet until it has received at least six or eight coats of gold-size. No varnish should be laid on thickly, otherwise it is liable to remain fluid in the interior, although apparently hard outside.

In commencing the practice of fluid mounting, it will be advisable for the student to make his first trials with some such fluid as camphor-water or diluted alcohol, as the difficulties of cleaning, &c., are much less than with saline solutions or glycerine.

A very ingenious process of fluid mounting forms the subject of a communication by Mr. T. C. White to the Quekett Microscopical Club (*Journal of the Quekett Microscopical Club*, vol. i., p. 147). He forms a cell with a thick varnish, made by dissolving gum damar in benzol. This is done by holding a brush charged with it against a slide while revolving on the turn-table. The cell will be ready in a few minutes, as it is used while half dry. The fluid and object are placed in the cell, and the cover glass put on, and pressed down into the cement, which adheres most tenaciously to wet glass. The surplus fluid is to be removed with blotting-paper, which may be used with the greatest freedom, as the glass is held very firmly by the damar varnish, another coat of which is applied by means of the turn-table, and the slide is completed. It would no doubt be more secure if finished with a few coats of gold-size. This process can only be used by those who are somewhat expert, as, should the first attempt fail, the cover cannot be removed and the process repeated. It is a very expeditious mode of mounting, and is likely, in some cases, to prove of great value. Mr. White states that he has had slides mounted for two years which are still perfectly sound and free from air-bubbles. The solution of damar may also be used as a very efficient substitute for the mixture of balsam and benzol. It is, like most varnishes, rather troublesome to make, as, owing to the impurities usually contained in the gum, the varnish requires straining; a somewhat difficult matter with so volatile a solvent as benzol.

The durability of objects, however mounted, is much influenced by the manner of storing them. Racked boxes and drawers are the worst possible receptacles, as from the vertical position of the slides they are liable to serious injury, those in fluid being likely to become leaky, and the balsam specimen sliding down, frequently, cover and all. Arrangements should be made for keeping the objects flat, which is now always done in well-constructed cabinets; it is also a great advantage to be able to see every slide, which is impossible in a racked box, and often causes much loss of time in searching for an object. For the convenience of those for whom the usual cabinets are too costly, Mr. Piper has invented some very ingenious trays, in which slides are placed horizontally; besides the merit of cheapness, they have the advantage of being extremely convenient. Five or six of these trays, with a mill-board at the top and bottom, may be fastened together with a couple of India-rubber rings, and any vacant shelf-room utilised for the storage of objects; a similar bundle of two or three trays is very convenient for carrying a small selection of objects in the pocket. Dr. Carpenter has used these trays placed in wooden cases made to resemble books, a very convenient way when bookshelves are vacant to receive them.

The chief difficulty of fluid-mounting will be found not to consist so much in the mechanical process of closing the object perfectly in its cell, as in the selection of a fluid suitable for its preservation.

A fluid which may be considered as a perfect medium—that is, one capable of preserving substances for an unlimited period without change, is at present unknown, and it is more than doubtful whether the discovery of such a fluid would be altogether an advantage, as use is frequently made of what some may consider the defects of preservative fluids, the alterations they induce in tissues submitted to their action often revealing facts of great importance. Some media are valuable, because they soak into tissues and render them transparent; this is the case to such an extent with glycerine, that Dr. Beale very appropriately calls it "The Canada balsam of moist tissues." Others are used for quite the opposite purpose, because they induce opacity, and very frequently do so partially, bringing out details somewhat in the same manner as is done by the colouring of a map, and which, without such aid, would be very imperfectly distinguished. Others are slightly corrosive, and clear away parts wished to be got rid of for the sake of bringing others more prominently into view.

In mentioning some of the very numerous media which have been used for mounting, the results can only be stated generally, and no fixed set of rules can be given, as the whole subject is at present in too imperfect a state. Much good might be done by observers mounting a series of the same object in different media, carefully labelling each slide with the date of mounting and the nature of the medium employed, and from time to time noticing and recording the result.

One of the great difficulties affecting the mounting of objects in fluid, arises from endosomotic action. When two fluids of different densities are separated by a permeable membrane, they will pass through and mix at very unequal rates. Supposing some dense fluid, like glycerine, inclosed in a bladder and immersed in water, the water would flow into the bladder faster than the glycerine made its way out; the result would be the expansion of the bladder. This is called endosmosis: the reverse action is known as exosmosis. With a view to observing practically the result of these actions, the student is recommended to obtain a specimen of some fresh-water conferva, such as are abundant in nearly every pond or aquarium. A portion of this conferva should be placed on a slide in a drop of water, covered with a thin glass, and examined with a power of fifty or sixty diameters. When the appearance of the plant is well impressed on the mind, remove the slide from the microscope, take off the cover-glass from the object, and with a piece of blotting-paper drain off (not blot up) as much of the water as possible. Now cover the conferva with some strong glycerine, replace the cover quickly, and examine without loss of time under the microscope, and notice the change that has taken place. The fluid contents of the conferva cells have suddenly emptied themselves into the surrounding glycerine, leaving the whole plant in a shrivelled and contracted state; in many cases the cells will be found to be ruptured, but those which have escaped injury will after a time expand and resume their natural appearance. In observing, advantage is sometimes taken of induced endosmosis, the tissues ruptured by this means often revealing points of structural detail difficult or impossible of demonstration by dissection. Endosomotic action may be prevented by introducing objects which contain light fluids very gradually into denser ones; for instance, an object should be passed from water into weak glycerine and then after a time into stronger, till at last it might be placed in glycerine of full strength without any contraction taking place. The same phenomena takes place if marine plants are immersed in fresh water. This may be familiar to some who have attempted to wash delicate sea weeds, such as *Griffithsia setacea*, in fresh water, the result being that the cells burst and stain the mounting paper; this may be prevented by washing in sea water, or water having gum or sugar dissolved in it, so that its specific gravity approaches that of sea water. An ingenious application of the principle of gradually increasing the specific gravity of the mounting fluid with a view to the prevention of endosmosis, will be found in the method known as Hantzsch's. The fluid consists of three parts alcohol, two of distilled water, and one of glycerine (Price's), all by measure. This medium is principally employed in mounting *Algæ*. The specimen is placed in the cell with this fluid and the cover put on, but not cemented, so as to allow evaporation to take place; the waste is supplied from time to time, until at last the cell contains nearly pure glycerine; it is then to be cemented as before described. The fluid is of very nearly the same specific gravity as water, so little or no endosomotic action takes place on the immersion of the specimen; and as the evaporation process increases the strength of the solution very gradually, the most delicate tissues can be eventually mounted in strong glycerine; doubtless this principle would answer equally well with a solution of chloride of calcium, a very valuable medium for certain preparations. Much valuable information respecting the collection and preparation of *Algæ*, will be found in "The Collector's Handy Book of Algæ," by Rev. W. W. Spicer, from which the above process is taken.

Taking the preservative fluids in groups, the simplest consist of water, either alone or in combination with some antiseptic substances.

Distilled water alone is capable of preserving such objects as the *Desmidiæ* and other *Algæ* in tolerable perfection as to form, although with more or less loss of colour and alteration of the disposition of the endochrome or cell contents. Confervæ are very apt to grow in slides in which distilled water is used; this is best prevented by saturating the water with camphor or creosote.

Camphor water is made by placing a lump of camphor in a bottle of distilled water, and allowing it to remain a few days; the water will then be found to smell very strongly, although the quantity dissolved is exceedingly small. Such portion as may be required for use is to be filtered and kept in a small bottle; the store bottle is to be filled up from time to time with distilled water. This fluid may be used with advantage in making and diluting all the preservative fluids mentioned in these papers instead of pure distilled water, unless an indication to the contrary is given in the formula. It is capable of preserving animal tissues as well as vegetable, but with the fault of most watery liquids, that it is apt in time to induce a granulous texture in objects of this kind mounted in it.

Creosote water is made in a nearly similar manner; a few drops of creosote are poured on a quantity of precipitated chalk, and the whole shaken up in a bottle of distilled water. When the chalk has settled, the clear liquid may be poured off and filtered as required for use; the preservative properties of this and also of a very diluted solution of carbolic acid closely resemble those of camphor water. For another use of carbolic acid see paper by Dr. Bastian, before quoted (Chemical News, vol. xx., p. 96).

Alcohol diluted with water, in various proportions, is much used for the preservation of large anatomical specimens; portions of injected tissue to be viewed as opaque objects keep very well in it, also vegetable structures where loss of colour is not objectionable. The striated structure of muscular fibre is well shown when this medium is employed; a piece of cooked meat will do to experiment upon. The fibres should be well separated with the needles before the cell is closed. Many other preparations are used for the preservation of objects.

Thwaite's Fluid.—Water, 16 ozs.; alcohol, 1 oz.; creosote and chalk, as in creosote water. Pour the creosote on the chalk as before, add the alcohol, stir up the whole, and add the water very gradually; allow the mixture to stand a few days, and then filter. Dr. Beale found that this solution was liable to become thick after a time, and gives the following substitute in his "How to Work with the Microscope:"—"Creosote, 3 drachms; wood naphtha, 6 ounces; distilled water, 64 ounces; chalk, as much as may be necessary. Mix first the naphtha and creosote; then add as much prepared chalk as may be sufficient to form a smooth, thick paste; afterwards add very gradually a small quantity of the water, which must be well mixed with the other ingredients in a mortar. Add two or three small lumps of camphor, and allow the mixture to stand in a lightly-covered vessel for a fortnight or

three weeks, with occasional stirring. The almost clear supernatant fluid may then be poured off and filtered if necessary; it should be kept in well corked or stoppered bottles." Dr. Beale states that he has had large preparations preserved in this fluid for more than twelve years, and that it is still bright and colourless.

Fluids are filtered by being strained through a conical bag made of a circular piece of porous paper manufactured for the purpose, folded in the usual manner, and supported in a glass or porcelain funnel of suitable dimensions. If the proper filtering paper is not at hand, white blotting paper will answer the purpose.

Chloride of Calcium (a saturated solution in camphor water).—For making this solution, the pure fused salt should be used, and not the common kind used for drying; it should be carefully filtered before use; it can be diluted to any extent with camphor water. The saturated solution is an extremely valuable preservative fluid; it soaks into objects, rendering them transparent, but rather less so than strong glycerine; it has the advantage, also, of not injuring calcareous tissues. Insects, viz., fleas and lice, mounted whole in this medium, with little or no compression, show the tracheal system and many of the internal organs remarkably well when properly illuminated, and are still in perfect condition; date of mounting, 1866. Flax, hemp, and other similar fibres display their structure far better in this than in any other medium, the secondary deposits being very clearly brought out.

Diluted Solution.—One part of saturated solution to ten of camphor water, answers well for the preservation of the fresh-water *Algæ;* the green colour is better preserved by it than it is in any other fluid.

Chloride of Sodium (common table salt).—A saturated solution seems to preserve *Entomostraca* very well indeed; it induces a slight degree of opacity, which is sometimes an advantage. Specimens of *Daphnia pulex* (water fleas) mounted in it in September, 1866, show much of the internal structure; the eyes and bundle of optic nerves are in very perfect condition. This solution is of value from its being readily procured anywhere, and a supply of specimens which would otherwise be lost may be preserved in it. Sea water impregnated with camphor or creosote will preserve various delicate marine animals and plants extremely well and without injury from endosmosis; by taking proper precautions they may be gradually transferred, if necessary, to strong glycerine.

Solution of arsenious acid in water has been used both alone and in combination with glycerine for the preservation of objects; the latter mixture has answered very well in re-mounting a series of injected preparations, which are now, after a period of about six years, in perfect condition. The quantity of arsenic capable of being dissolved in water is extremely small; solutions of arsenic, unless saturated with camphor, are especially liable to confervoid growths, a rather unexpected phenomenon in so poisonous a fluid.

Many other saline solutions will be found in microscopical works. The best have been given above; a larger selection would tend rather to confuse than assist the beginner.

Glycerine is one of the most valuable materials ever added to the resources of the microscopist. We are indebted to the late Mr. Robert Warrington for the application of this fluid to microscopical purposes. It is obtained as a waste product in the manufacture of soap, and lead plaster. The quality of the glycerine from these sources is very inferior, being both weak and impure. The best is that made by Price's Patent Candle Company, and obtained by a distillation process. This is much purer and stronger than the common kind, having a specific gravity of about 1240, and is the only kind fit for use by the microscopist. The properties of glycerine as a means of giving transparency to an object have already been mentioned. It is a thick, syrupy, and highly refractive fluid, nearly colourless, and intensely but pleasantly sweet. Although made from fat, it is not at all greasy, but freely miscible with water and many other fluids; it is also a solvent for a great number of substances. Its action upon varnish has already been alluded to. It is stated by Dr. Carpenter that it dissolves carbonate of lime readily, and quite destroyed the calcareous skeleton of certain *Echinodermata* mounted in it. He suggests that, when used for such purposes, it should be saturated with carbonate of lime by being kept in a bottle with some fragments of marble ("Microscope and its Revelations," fourth edition, p. 222). One of the advantages of glycerine is that it never dries; so that an object can be placed in it, covered with a glass, and left uncemented, without fear of evaporation for any length of time, and afterwards mounted permanently, if desired. Owing to its free miscibility with other substances, it forms many very valuable compounds, some of which will presently be described. A very full account of its use in delicate physiological investigations is given in Dr. Beale's "How to Work with the Microscope," a book of the greatest service to all intending to study the particular subjects upon which it treats. It is by the use of glycerine that Dr. Beal has succeeded in carrying on his elaborate investigations of the ultimate structure of nerve tissue under excessively high powers; and his processes afford a remarkable illustration of the support afforded to a delicate tissue by immersion in a fluid of extreme density, the manipulation of tender substances being comparatively easy in glycerine, when, in water or alcohol it would have been impossible.

Strong glycerine preserves nearly every kind of object, whether animal or vegetable, with great perfection, and is, perhaps, the nearest approach to an universal mounting-fluid yet known. Insects and other objects may be put into a bottle of glycerine, and left until wanted; they are even better after a year or two's soaking. Objects mounted in glycerine generally improve after a time, details often being visible which were not seen immediately after mounting. The introduction of the binocular microscope has very much influenced the style of mounting objects to be viewed with low and medium powers. For this purpose, it will be found advantageous to mount the object with little or no compression. Of course, for examination with high powers, thin and compressed specimens are absolutely necessary (see author's paper, *Monthly Microscopical Journal*, vol. i., p. 331).

Glycerine can be diluted to any extent, either with camphor or creosote water, should it be desired to obtain a less refractive fluid, and one which does not render objects so transparent as pure glycerine; sometimes a portion of alcohol may be added with advantage. This compounding of media is one of the greatest arts in fluid mounting, and can only be acquired by experience, as, at present, no definite directions can be given. Diluted fluids, as a general rule, make animal tissues more granulous and opaque after a time than

the strong, dense ones. The author possesses an instance of a difficult mounting accomplished almost by chance. The subject was the Medusoid embryo of *Hydra tuba*, which he had been observing at a friend's house. Thinking it a pity to lose a specimen then seen for the first time, he took the object home alive in its cell of sea-water, and then determined to attempt its permanent preservation. The course of operation was as follows:—The slide was placed in a saucer, which was quickly filled with strong alcohol (about 60 over proof). This fortunately killed the animal so suddenly that it was but little contracted. A mounting-fluid, consisting of glycerine, alcohol, and sea-water, was then extemporised, and the object mounted. It is still in good preservation, although somewhat opaque. It was mounted in February, 1862. This is given as an instance of the kind of practice occasionally needed in cases of emergency, and where the tact acquired by experience may be turned to good account.

It is occasionally convenient to make use of a medium which, while it is fluid at the time the object is mounted, will ultimately harden, and preserve the object from injury from being shaken or moved. Such media are especially useful for mounting *Diatomaceæ* attached to other *Algæ*. There are many compounds of this nature, some of the best of which are largely composed of glycerine.

The earliest of these was that known as *Deane's gelatine*. It is composed of—Gelatine, 1 oz.; water 4 ozs.; honey 5 ozs.; creosote, 6 drops; alcohol, ½ oz. The gelatine is to be soaked in the water until quite soft; the honey, heated to the boiling point, is to be added. The whole is then to be boiled, and, when it has cooled a little, the creosote and alcohol, mixed together, are to be added, and the whole filtered through fine flannel.

Glycerine jelly consists of gelatine soaked in camphor-water until it swells and becomes soft. The surplus water is to be poured off, and the jelly strained, and, if necessary, clarified after the manner of confectioners with white of egg. To every ounce by measure of this jelly add 1 drachm of alcohol and 6 drachms of Price's glycerine.

Both these media are used by melting the composition by placing the bottle in hot water, just as glue is melted. It is then used almost precisely in the same way as Canada balsam, taking the precaution to prepare the object by a previous soaking. Thin objects do not require a cell. When the gelatine has hardened sufficiently, the surplus portion is scraped off, and the slide cleaned. It should then be secured with a coat or two of liquid-glue, followed by several coats of gold-size, as in moist preparations.

A very useful medium of nearly similar properties is made according to the following formula of Mr. Farrants:—Picked gum arabic, 4 parts by weight; water, 4 parts; glycerine, 2 parts. The mixture is to be made cold, and, if necessary, strained through fine muslin. It is to be used in the same manner as the foregoing gelatinous preparations, only without heat, which renders it particularly fit for objects that will not bear the slight increase of temperature required to liquefy gelatine.

The action of all the above media is nearly similar to that of slightly diluted glycerine, excepting that, when set, they keep the object fixed in the position in which it was mounted.

Strong syrup is capable of preserving animal and vegetable tissues, but is, under some conditions, liable to crystallise. The best proof of the perfect manner in which vegetable substances are preserved is given in the condition of preserved fruits, which are in an extremely favourable condition for microscopical examination. The samples of jam, &c., examined by Dr. Hassall, and reported upon in his "Food and its Adulterations," were probably among the tissues most easily identified, owing to their perfect condition.

Castor-oil will be found an excellent mounting-fluid; it penetrates, and gives considerable transparency, and keeps the object well and for a long period. It is particularly successful with parasitic insects; these may be placed in a bottle of castor-oil, and kept until required for mounting. As castor-oil is so readily procured, being in every medicine-chest, and to be obtained at any little village shop, it is a very useful medium for those who may wish to preserve insects, &c., captured while travelling, as they need no attention after they are immersed in it. Should it be desired to mount the objects ultimately in some other medium, the oil can easily be removed by soaking in benzol.

Mounting-fluids which are in frequent use are best kept in a small, wide-mouthed bottle, through the cork of which is passed a pipette, surmounted by a funnel at its upper extremity, upon which is stretched a piece of sheet-india-rubber (Fig. 18). By this contrivance,

Fig. 18.

a small quantity of fluid can be taken up, and delivered, drop by drop, upon the slide. Where mounting-fluids are continually required, as in pathological laboratories, Dr. Beale has contrived a little fountain on the principle of the wash-bottle, which answers admirably for a supply of any kind of fluid in drops; but, for the occasional use of the student, the pipette-bottle is to be preferred.

Closely connected with fluid-mounting is the process of staining tissues. This is used for two widely different purposes. The first for rendering very transparent bodies more easily visible; this is easily done by immersion in magenta, diluted as the particular case may require. The other for more clearly defining certain parts, or parts in a particular state; this is done by using staining fluids which act unequally. For instance, if it be desired to stain the nuclei of cells, the following solution of carmine, described by Dr. Beale in "How to Work with the Microscope," and reprinted here by his kind permission, will answer admirably:—"Carmine, 10 grains; strong liquor ammoniæ, ½ drachm; Price's glycerine, 2 ozs.; distilled water, 2 ozs.; alcohol, ½ oz. The carmine, in small fragments, is to be placed in a test-tube, and the ammonia added to it. By agitation, and with the aid of the heat of a spirit lamp, the carmine is soon dissolved. The ammoniacal

solution is to be boiled for a few seconds, and then allowed to cool. After the lapse of an hour, much of the excess of ammonia will have escaped. The glycerine and water may then be added, and the whole passed through a filter or allowed to stand for some time, and the perfectly clear supernatant fluid poured off and kept for use. This solution will keep for months, but sometimes a little carmine is deposited, owing to the escape of ammonia, in which case one or two drops of liquor ammoniæ to four ounces of solution may be added." For further information relative to the application of the staining process, and the observations to be carried out by its means, the student is referred to Dr. Beale's work.

Solutions of chloride of gold and nitrate of silver may also be employed to advantage (see paper by Dr. Bastian before quoted; T. Dwight, *Monthly Microscopical Journal*, vol. ii., p. 45).

Next in importance to the possession of a good instrument, is the having a good supply of light, and knowing how to make proper use of it. The sources of light available for the microscopist's use have already been described; the ways of utilising the light so obtained, and the instrumental appliances for directing it, form the subject of this chapter.

The natural division of illuminators is into two classes—those which act above the stage of the microscope, and send light down upon an object; and those which are placed below the stage, and send light through it.

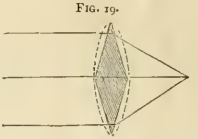
Of instruments of the first class, one—the *condensing lens*—is usually supplied with every microscope, however plainly equipped. This lens enables light to be concentrated upon the object on the stage; either a double-convex or a plano-convex lens may be used for this purpose. If the first is employed, no particular attention is required beyond placing it at such a distance above, and on one side of the stage, that the light falls at a suitable angle, and that the object is in or near the focus; should a plano-convex lens be used, its position is of some importance, as, if it is turned the wrong way, its spherical aberration is greatly increased, and, of course, a corresponding amount of light lost. The plano-convex lens, or bull's-eye, when used to concentrate parallel rays—daylight, for instance—or divergent rays, such as those proceeding from a lamp, should always be placed with its convex side turned towards the source of light, as the spherical aberration is then much less than it would be when placed in the contrary direction; if the lens is to be used for rendering parallel the divergent rays of a lamp, then the bull's-eye is to be placed in the opposite position, with its flat side turned to the lamp, and at a distance from the flame equal to its focal length. Parallel rays are required when using some of the illuminating apparatus presently to be described.

Very much may be done with the condensing lens, if skilfully used; especial care is required that it causes the light to fall on the object in the right direction, as the appearance of the surface of many substances is very different when illuminated from opposite sides; the student should, therefore, never be contented with a single observation of a strange substance, but should change its position, so that it may be viewed with the light falling upon it in as many directions as possible. This is most easily effected by causing the object to rotate while the light is directed upon it, so that the alteration caused by every change of position can be easily noted. The necessary movement is now very generally fitted, even to the stages of small instruments, and persons about to procure a microscope would do well to incur the small extra cost of this useful addition.

The light obtained by the condensing lens may be greatly augmented by using two, one of larger dimensions than the other, the light being brought to a certain degree of convergence by the first and larger lens, and afterwards concentrated by passing through the smaller one, which should be so placed as to intercept the cone of light from the large lens at the place where it is of its own diameter.

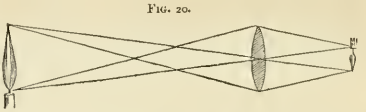
Most of the other illuminators of this class act by reflection, mirrors of various forms being employed. The optical properties of concave mirrors resemble, in many points, those of convex lenses; they cause parallel rays to converge (Fig. 19), render divergent rays par-

Fig. 19.



allel, or convergent, and also form images (Fig. 20). Microscopes and telescopes can be constructed with

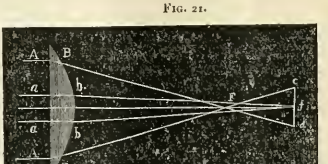
Fig. 20.



mirrors or specula, instead of object-glasses; this principle is still in use as regards telescopes of large dimensions, as the difficulties of making object-glasses of large diameter are very great; the largest yet accomplished is only 25 inches, while the largest speculum (that of the late Lord Rosse) is 6 feet in diameter.

Professor Amici constructed a very efficient compound microscope, having an elliptical speculum in place of an object-glass; the plan, however, was abandoned on the introduction of the achromatic principle, although its performances were very superior to those of the non-achromatic instrument.* Concave mirrors, when formed of segments of spheres, are liable to spherical aberration, just as lenses are (Fig. 21); therefore, when it is required to render

Fig. 21.

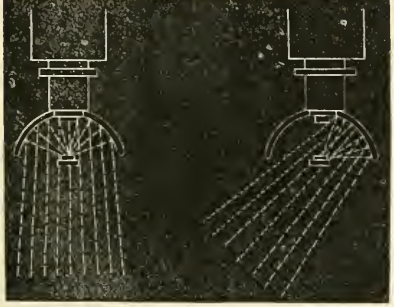


divergent rays parallel, or bring parallel rays to a focus,

* One of these instruments has recently been presented to the Royal Microscopical Society; there are also several old and curious microscopes in the Society's collection.

it is necessary that the figure of the mirror should be that of a parabola. Specula of this form are used in astronomical telescopes, the reflectors of lighthouses on the catoptric principle, and in some instruments presently to be described. The parabolic curve differs from the circle principally in being flatter at the edges and deeper at the centre. Reflecting instruments are entirely free from chromatic aberration. The oldest of the reflecting illuminators is that known, from the name of its inventor, as the *Lieberkuhn* (Fig. 22); it

Fig. 22.



consists of a spherical silver mirror, perforated, to allow it to slide over the setting of the object-glass, and is so adjusted that the focus of the speculum is coincident with the working distance of the object-glass. The object is illuminated by light reflected through the hole in the stage by means of the mirror; this is again reflected, but in a very convergent state, upon the object, which will be intensely illuminated if the speculum is well adjusted to focus and properly supplied with light.

It is necessary to place beneath the object a black stop of sufficient size to fill the field of the object-glass, otherwise the light from beneath entering the microscope will cause a disagreeable amount of fog and indistinctness. The best kind of background consists of a dark well or little cup of proper size painted black inside, and placed below the object; a patch of black paper or paint will, however, answer the purpose. Beck's disc holder (Fig. 23) is particularly useful for objects to be examined by the aid of the lieberkuhn, as it forms its own black stop. Its late talented inventor

Fig. 23.

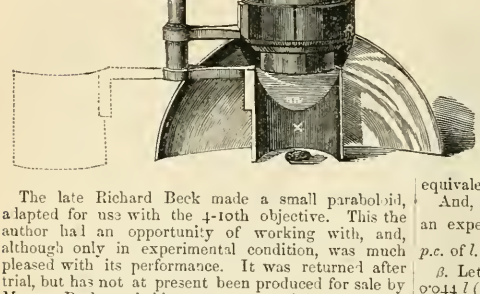
was very expert in the employment of this kind of illumination. The defects of the lieberkuhn are that its light is nearly vertical, and therefore, like the tropical mid-day sun, casts little or no shadow; this, however, may be remedied, to some extent, by turning the mirror aside and using the light from only one-half of the speculum (Fig. 22, B); also it requires the object and its mounting to be small enough to allow the free passage of the light around it from the mirror.

These defects caused the lieberkuhn to fall somewhat into disuse; the introduction of the binocular microscope, however, caused it again to be employed, as it was found very suitable for the peculiar class of opaque objects which are so well displayed in relief by its stereoscopic power. It has, however, again been nearly superseded by an improved form, which has all its advantages besides some peculiar to itself. This improved instrument, which is known as the *parabolic lieberkuhn* (Fig. 24), is another of the numerous contrivances of the late Richard Beck, and was described by him in the *Microscopical Quarterly Journal* for 1865 (vol. xiii., p. 116). It consists of a portion of a silvered paraboloid, which is attached by a ring to the setting of the object-glass, so that it has some range of adjustment like the ordinary lieberkuhn, but instead of the light being directed upon it from below through the hole in the stage, it is supplied from one side, which allows this form of lieberkuhn to be used with objects mounted in the ordinary way. It is necessary when lamp light is used that the rays should be rendered parallel by placing a condensing lens between the lamp and the reflector, as before mentioned. As there is a very large reflecting surface, and from the parabolic figure of the mirror no spherical aberration, the amount of light concentrated upon the object is much greater than could be obtained from the ordinary spherical lieberkuhn. It has also the advantage of reflecting rays from one side only and of considerable obliquity. These properties make it the most perfect illuminator yet produced for viewing opaque objects by reflected light. Its effect is almost like that of brilliant sunshine, lighting up the interior of every cavity, and yet, at the same time, casting strong shadows and defining minute portions of structure in a manner hitherto unapproached. The paraboloid as usually constructed is adapted for use with objectives of from 2 inches to two-thirds focus. A very ingenious mounting, allowing a very large range of adjustment to be given to the paraboloid, has been contrived by Mr. Crouch, who uses a short adapter screwed into the body of the microscope as a support to the reflector and its fittings, which consists of sliding tubes and ball-and-socket joints, by means of which it can be placed in extremely varied positions, and is adapted for use with any microscope or object-glass fitted with the universal screw. It must be borne in mind that these advantages are gained at the expense of removing the object-glass a small distance, viz., the length of the adapter from the Wenham prism, while, to obtain the best possible definition, the back lens of the objective cannot approach the prism too closely; therefore in making choice between the two forms of mounting the paraboloid, the student must consider whether convenience with a trifling loss of definition will suit him, or whether the most perfect definition is required with the trifling inconvenience attending the ordinary form.

An addition to the parabolic lieberkuhn, consisting of a small plane mirror (Fig. 24, *m*) inclined at an angle of 45°, which is so fitted that it can be brought into the proper position for reflecting light vertically upon the object, by means of the milled head, w, has been made by Messrs. Beck, at the suggestion of Mr. Sorby, who required this contrivance for viewing the polished surfaces of specimens of iron and steel. When light is

directed obliquely upon a highly polished surface, it is reflected at an angle equal to the angle of incidence, none of it enters the microscope, and the surface appears intensely black, but when illuminated vertically, all its structural peculiarities are at once brought into view. For such researches the plane speculum is indispensable, and its adaptation in no way interferes with the ordinary use of the paraboloid.

Fig. 24.



The late Richard Beck made a small paraboloid, adapted for use with the 4-10th objective. This the author had an opportunity of working with, and, although only in experimental condition, was much pleased with its performance. It was returned after trial, but has not at present been produced for sale by Messrs. Beck, probably on account of its value not being generally known. From its very short focus, it requires much more careful fitting to the objective it is intended to be used with than the larger paraboloid; but when carefully executed, it works quite as well with its own object-glass as the one above mentioned with the lower powers. The author, however, possesses one which was made for him by Mr. Bailey, of 162, Fenchurch Street, which performs admirably, and is executed in this optician's usual careful manner. The parabolic lieberkuhn is of great value with ½ ioch and 4-10th objectives, as these glasses allow but little space between the front glass and the object for illumination with the condensing lens.

A very efficient illuminator was, until recently, much in use; it is known as the *side reflector*, and consists of an oblong silvered mirror of spherical figure. It has ball-and-socket and sliding adjustments, and is attached either to the stand of the microscope or else is mounted upon an independent support; it is placed on one side of the instrument, and the light directed upon it from the opposite side. The speculum is then adjusted until the object is properly illuminated. It has, however, been superseded by the parabolic lieberkuhn before described.

(To be continued.)

VOLUMETRIC SOLUTIONS FROM WHICH THE PERCENTAGES MAY BE READ OFF IN THE NUMBER OF VOLUMES REQUIRED.

BY WATSON SMITH, F.C.S.

The great advantage to commercial analysts of a method of constructing volumetric solutions from which the percentages may be read off in the number of volumes of such solutions required, or ascertained by a very simple calculation which can be mentally performed with ease, is, I think, palpable. The following is an outline, with examples of the methods of calculation required in titrating these solutions:—

For the sake of brevity, let x = weight of body taken, in which it is required to find the percentage of l; let n = number of volumes of solution required, and *p.c.* stand for percentage.

1st. Solutions from which the *p.c.* may be read off directly, or *p.c.* $= n$.

The solution is so made that the weight of l, to which each 100 volumes is equivalent, $= x$; or, in other words, the solution is so made that 100 vols. thereof shall just be equivalent to the amount of l in the weight, x, of the body, supposing it to contain 100 *p.c.* of l.

From the foregoing, it will be seen that, for each solution, x must be a constant weight, in order that the percentages may be obtained in each special manner.

Now, by way of verification, let $x = 10$.

a. Then each volume of solution must be equivalent to 0·1 l or 100 vols. $= 10\ l$.

And, say, 55 vols. of solution have been required in an experiment, then the body contains $\frac{55 \times 0{\cdot}1 \times 100}{10} = 55$ *p.c.* of l.

β. Let $x = 4{\cdot}4$. Each volume of solution must $=$ 0·044 l (100 vols. $= 4{\cdot}4\ l$); and, say 55 vols. of solution have been required, the body contains $\frac{55 \times 0{\cdot}044 \times 100}{4{\cdot}4}$ $= 55$ *p.c.* of l.

As practical examples, take the following:—

a. It is required that the *p.c.* of NH_3 in a sample of ammonium sulphate be ascertained. Let 5 grms. $= x$ (see Chemical News, Notes and Queries, vol. xx., p. 168; *Am. Repr., Dec. '69. page* 391; then the acid solution (say hydrochloric) must be made so that each c.c. is equivalent to 0·05 grm. of $NH_3 = 0{\cdot}091$ grm. Na_2O.

This is done by weighing out $\frac{106 \times 2{\cdot}5}{132} = 2{\cdot}008$ grms. of sodic carbonate (pure and freshly-ignited), and making the acid so that 50 c.c. thereof are just sufficient to neutralise this 2·008 grms.

A *sodic-carbonate* solution must now be made, exactly equivalent to the acid solution; *i.e.*, 100 c.c. must contain $\frac{5 \times 106}{132} = 4{\cdot}015$ grms. of Na_2CO_3, or 40·15 grms. per litre. Therefore, 40·15 grms. of pure freshly-ignited sodic carbonate must be weighed out, dissolved in pure distilled water, and diluted to 1 litre.

Now, supposing the NH_3 has been distilled off, from the weight of sulphate taken, into 24 c.c. of the HCl solution, and 3·5 c.c. of sodic carbonate solution have been required to neutralise the excess of HCl, then 24 — 3·5, = 20·5 *p.c.* of NH_3 are contained in the sample of sulphate.

b. Again, a convenient "test acid" for estimating the *p.c.* of soda in samples of sodic carbonates and hydrates may be made as follows:—Dilute a quantity of sulphuric acid with about its own bulk of water, and let stand till cold; then further dilute till a Twaddell's hydrometer marks in it 10¾° (which indicates about the sp. gr. of the required acid). 5 grms. of pure freshly-ignited sodic carbonate are now weighed out, and the acid is so adjusted that 58·5 c.c. are just re-

quired for neutralisation. (N.B. Pure Na_2CO_3 contains 58·5 Na_2O.)

2nd. Solutions of decimal strength, or in which $p.c. = n \times 0{\cdot}1$.

Where the reagent from which the volumetric solution is to be made is expensive, and the percentages happen to be low, a more dilute liquor is used, and thus a smaller weight, to represent x, is to be taken. Thus, for example, a convenient silver solution, for the determination of the *p.c.* of NaCl in samples of salt-cake, may be made as follows:—

Let $x = 2$ grms. Make the nitrate of silver solution of such strength that each c.c. = 0·002 grm. of NaCl—*i.e.*, equivalent to 2 grms. of NaCl per litre of silver solution, or 0·2 grm. of NaCl per 100 c.c. Now 2 grms. of NaCl are equivalent to $\frac{2 \times 170}{58{\cdot}5} = 5{\cdot}81$ grms. of $AgNO_3$; therefore weigh out 5·81 grms. of $Ag\,NO_3$, dissolve in pure distilled water, and dilute to 1 litre.

From the preceding, it is seen that the silver solution is so made that 100 vols. thereof shall be equivalent to the amount of $l \times 0{\cdot}1$ in the weight, x, taken (supposing x to contain 100 per cent of l); so that n vols. being required, $p.c. = n \times 0{\cdot}1$.

3rd. Solutions of half strength are, also, often useful where the *p.c.* of l is usually very large, and but a small quantity of the body can be conveniently taken (to represent x), for various reasons. In this case $p.c. = n \times 0{\cdot}5$.

For a solution of the above strength, 100 vols. of such solution must be equivalent to the amount, $l \times 0{\cdot}5$, in the weight, x, taken (supposing x to contain 100 *p.c.* of l); so that if $x = 1$ grm., and $n = 30$ c.c. $30 \times 0{\cdot}5$, or $\frac{30}{2} = 15$ *p.c.* of l, are contained in the body experimented upon.

Of course, by varying the weight, x, in a particular manner, the same solution may be actually altered from decimal to half strength, or from half to full strength, &c.; thus, from decimal to half strength, take 1-5th x; from half strength to full strength, take $\frac{1}{2}x$; and from decimal to full strength, take 1-10 = x.

The burette, which is used for titrating each solution, should be always used for that particular solution, as burettes which are graduated to hold equal volumes are very often found erroneous.

ECLIPSE OBSERVATIONS.

Among the various observations made at the last eclipse, none exceed in interest those of Professor C. A. Young, of Dartmouth College, Hanover, New Hampshire. We quote from the *Journal of the Franklin Institute* an abstract of this gentleman's report:—

The observer was a member of the party under the direction of Professor J. H. C. Coffin, of the Nautical Almanac Office, stationed at Burlington, Iowa.

The instrument employed was a spectroscope with 5 prisms of 45° each, having faces 2¼ by 3¼ inches; the collimator and telescope had apertures of 2¼ inches, with a focal length of 17. These were connected with a "comet seeker" of 4 in. aperture and 30 in. focus, used with an eye-piece, and giving an image of the sun, 2½ inches in diameter, on the slit of the spectroscope. A graduated screen at the slit determined positions of points on the sun's limb, and a wire micrometer measured the positions of spectrum lines. The whole was mounted equatorially with slow motion screws.

Protuberances were noted before the eclipse at + 85° to 100°, large and not very bright; at + 146°, small and bright. The photographs show another at 155°, which escaped notice; also at — 70° to 80° low, but pretty bright; and at — 130°, very large and bright, the principal one. Angles are reckoned on the sun's limb from the North point, + towards the East, — towards the West.

The first contact was observed by watching the gradual shortening and final extinction of the bright line, c, in the spectrum of the prominence, which happened to be at the point of contact. The moon's approach was perceived full thirty seconds before its actual appulse; the observation was perfectly easy, and the time determined is certainly to be relied on within half a second, and probably much less. The presence of a prominence at the point of contact is not essential to the success of the method, as there is everywhere on the sun's limb sufficient depth of chromosphere to answer the purpose.

It is proposed to apply the spectroscope to observations both of the external and internal contacts at the next transit of Venus.

During the totality, the following nine bright lines were observed in the spectrum, viz., c dazzling in brilliance; 1017·5 (near D, the numbers refer to Kirchhoff's scale), very bright, but not equal to c; 1250 ± 20, very faint, position only estimated; 1350 ± 20, like the preceding; 1474 (a little below E) conspicuous, but not more than half as bright as 1017·5; F, next to c in brightness; 2602 ± 2, a little fainter than 1474, position determined by micrometrical reference to the next; 2796, a little below G, the well-known H.γ line in brightness between 1017·5 and 1474; and finally H, or Hδ, somewhat brighter than 1474. B was not seen, it is supposed on account of a mistake in carrying that portion of the spectrum through the field while there was no prominence on the slit.

*The line 1474 was recognised as belonging to the spectrum of corona, in the first place, by its extending clear across the spectrum, while 1017 did not, and then by its remaining visible when the slit was moved away from the protuberance, while the other lines (c and 1017) disappeared. The impression of the observer is that faint lines 1250 and 1350 behaved in the same manner, but his recollection as to this point is not very certain.

These three lines, 1250, 1350, and 1474, coincide far within the probable errors of observation with three lines observed by Professor Winlock in the spectrum of the Aurora Borealis. The two first are not accurately enough determined, in position, to allow much stress to be put upon any apparent coincidences on their part, but the last is perfectly well known, and its exact agreement throughout with one of the fainter lines

* A careful examination of the photographs of the prominences on the eastern limb of the sun, upon which the slit of the spectroscope was directed during the first half of totality, somewhat diminishes my confidence in the conclusion of the text, as to the nature of these three lines. I think it absolutely certain that they do not belong to the spectrum of the brilliant portion of the prominences; but the photograph shows, in addition, an extensive nebulosity surrounding the nuclei with a pretty definite boundary of its own; this nebulosity is best seen in No. 2 of the totality pictures taken at Burlington. Now, it is possible that these lines may belong to this nebulosity, and not to the corona proper; for I cannot recall, with certainty, whether the 1474 line retained its brilliance at any considerable distance from the prominences. My impression is that it did, and that the text is correct, but do not wish to be too positive. The eclipse of December, 1870, will decide, of course.

of the Aurora, when combined with the general appearance of the Corona and other considerations, give a good deal of probability to the conjecture that our Aurora Borealis and the Solar Corona are identical phenomena.

The line 1474 is given by both Kirchhoff and Angström (not by Huggins, who, however, omits many faint lines), as belonging to the iron spectrum, and this suggests the inquiry whether we are to admit the existence of iron in the auroral heights of our atmosphere, or are to account for this line in the iron spectrum by some unknown substance of gaseous nature.

The corona showed, also, a faint continuous spectrum without any trace of dark lines. The light of this faint spectrum, tested by a tourmaline held in the hand next the eye, was strongly polarised in a plane passing through the sun's centre. As the direction of the spectroscope slit was nearly radial, it is not impossible that Professor Pickering may be right in explaining this polarisation as caused by the successive refractions through the prisms.

Professor Young's remarks, in his note on the lines in the corona or glow, are curiously in accordance with those of Dr. B. A. Gould, given in the same journal as an extract from a letter to its editor, Professor Henry Morton, who organised and conducted the largest and most successful photographic party during the late eclipse.

Photographs of the Chromosphere.

In a letter just received from Dr. B. A. Gould, we find the following interesting paragraphs, which, with his permission, we extract:—

"An examination of the beautiful photographs made at Burlington and Ottumwa, by the sections of your party in charge of Professors Mayer and Himes, and a comparison of them with my sketches of the corona, have led me to the conviction that the radiance around the moon, in the pictures made during totality, is not the corona at all, but is actually the image of what Lockyer has called the chromosphere.

"This interesting fact is indicated by many different considerations. The directions of maximum radiance do not coincide with those of the great beams of the corona; they remained constant while the latter were variable; there is a diameter, approximately corresponding to the solar axis, near the extremities of which the radiance upon the photographs is a minimum, whereas the coronal beams in these directions were especially marked during a great part of the total obscuration. The coronal beams stood in no apparent relation to the protuberances, whereas the aureole, seen upon the photographs, is most marked in their immediate vicinity. Indeed, the great protuberance, at 230° to 245°, seems to have formed a southern limit to the radiance on the western side, while a sharp northern limit is seen on all the photographs at about 350°, the intermediate arc being thickly studded with protuberances, which the moon displayed at the close of totality. The exquisite masses of flocculent light on the following limb are upon the two sides of that curious prominence at 93°, which at first resembled an ear of corn, as you have said, but which in the latter pictures, after it had been more occulted, and its southern branch thus rendered more conspicuous, was like a pair of antelope horns, to which some observers compared it. Whatever of this aureole is shown upon the photographs, was occulted or displayed by the lunar motion, precisely as the protuberances were. The variations in the form of the corona, on the other hand, did not seem to be dependent in any degree upon the moon's motion.

"The singular and elegant structural indications, in the special aggregations of light on the eastern side, may be of high value in guiding to a farther knowledge of the chromosphere. They are manifest in all the photographs by your parties which I have seen, but are especially marked in those of shortest exposure, such as the first one at Ottumwa. In some of the later views they may be detected on the other side of the sun, though less distinct. But the very irregular and jagged outline of the chromosphere, as described by Janssen and Lockyer, is exhibited in perfection.

"This happy result is clearly attributable to the relative shortness of the time of exposure by which the highly photographic rays of the chromosphere have depicted themselves, without obliteration by the mass of coronal light which veiled them from the eye. Let us hope that at the next total eclipse some impressions may be taken with an exposure not exceeding a single second, as you have suggested. The inference seems warrantable that in this way, better than in any other, the internal structure of the protuberances may be exhibited, though other phenomena may fail to record themselves.

"You will observe that some of the brighter, petal-like flocculi of light have produced apparent indentations in the moon's limb at their base, like those at the basis of the protuberances. These indentations are evidently due to specular reflection from the moon's surface, as I stated to the American Association at Salem last month. Had any doubt existed in my mind previously it would have been removed by an inspection of the photographs.

"I shall send the substance of these remarks to Professor Coffin, as a sort of postscript to my report, which contains only the results of personal observations at the time."

SIMPLE APPARATUS

FOR

RAPID VAPOURISATION AT LIMITED HEAT,

UNDER REDUCED PRESSURE, WITHOUT USE OF A PUMP.

BY A. B. PRESCOTT,

Assistant Prof. of Chemistry, &c., University of Michigan, U.S.

The pump is not always at hand; its use is forbidden for transmission of corrosive vapours; and, moreover, the removal of liquids, in form of vapour, against the weight of the air by muscular power is liable to "exhaust" the operator more effectively than it does the material. I desire to ask attention to some uses of ordinary distilling apparatus, for the production and maintenance of approximate vacuum over liquids during their vapourisation, in cases where the heat of 120° to 150° F. may be applied.

It is necessary that the distilling apparatus be made capable of air-tight closure, and that the air be removed from it to begin with. Then the degree of exhaustion in the apparatus is in direct ratio to the rapidity of condensation of the vapour produced. And the rapidity

of condensation is only limited by the degree and extent of refrigeration employed, with a given extent of evaporating surface at a stated temperature. The air in the apparatus, to begin with, may be expelled through a suitable aperture by steam, which may be generated in the "receiver" of the apparatus or in an attachment thereto.

Take two round-bottomed glass flasks, the one having a capacity four to eight times greater than the other. Adjust the smaller upon a water-bath, the larger, at 10 or 15 inches distance from the other, over a sink or large basin, and connect the two with glass tubing and perforated caoutchouc stoppers, so that the connecting-tube shall incline slightly downward from its bend close to the stopper of the small flask. The stopper of the small flask is also to have a second perforation, in which is fitted a straight glass tube, 2 or 3 inches long, its lower end placed even with the lower end of the stopper. The upper end of this tube is very slightly drawn out for ¼ of an inch, and snugly fitted with 1½ inches of firm rubber tubing, the upper ½ inch of which is closed with a piece of glass-rod of same diameter as the body of the tube.

Now put an ounce or two of water in the large flask, and the material to be evaporated in the small flask; close the stoppers perfectly, by turning the flasks under them, and leave open the straight tube. Apply, by the water-bath, the limited degree of heat until it is imparted to the contents of the small flask; then move a lamp under the large flask until the water in it has boiled briskly and the steam therefrom has escaped continuously from the straight tube for some minutes. Now close tightly the straight tube with its caoutchouc cap, at the same time removing the lamp from the large flask. When the latter has cooled somewhat, wrap it smoothly with linen netting or gauze, and lead upon it a minute stream of cold water, controlling the same as required. The liquid in the small flask boils briskly (if aqueous, boiling at 120° to 150° F.), and the refrigeration is governed to prevent too violent ebullition, lest liquid be thrown into the connecting-tube; the degree of applied heat is governed to the same end.

An ordinary glass retort may be substituted for the small flask as an evaporating vessel, and its tubule may be fitted with a perforated stopper, admitting a thermometer. If there is not room in the stopper (of retort or flask) for both the thermometer and the steam-escape tube, the latter may be dispensed with by adjusting the stopper loose for escape of steam, and pressing it tight when the air is expelled. Flat-bottomed flasks favour equable boiling, but they are liable to collapse.

As a *condenser*, I have used, instead of the large flask, a copper vessel, for more ready application of heat without danger of breaking, and for more efficient refrigeration. This copper receiver (Fig.) is made of conical shape, with rounded bottom, a vertical diameter twice its horizontal diameter, and a neck bent to the angle of about 56° with the vertical axis of the vessel. The diameter of the neck is ¾ of an inch, to receive a retort beak, the joint being covered with a section of caoutchouc tubing. Or it may be fitted with a perforated stopper, to receive the connecting-tube of the flask when evaporation is conducted in the latter.

With linen netting to spread the water over the free surface of the condensers, the evaporation therefrom refrigerates with a comparatively small supply of water. Using a copper condenser of the above-described shape, a vertical diameter of 12 inches, and capacity of 6 pints, attached to an 8-ounce glass retort containing distillation promoters, I have vapourised 4 fluid ounces of water in sixteen minutes at the constant temperature of 128° F. By ordinary care in the expulsion of air and closure of the apparatus, exhaustion can be invariably secured, fixing the water boiling-point at or below 130° F.; that is, atmospheric pressure equal to at least 25 inches of mercury may be removed and sustained by availing ourselves of the displacing effect of steam, and the contraction of condensing vapour, in very simple apparatus.

Notwithstanding the illustrations of vacuum by condensation which abound upon the physical lecture-table, I do not know whether the devices suggested in this note have been tried or proposed for small chemical operations by anyone else. I have recommended them to students, and we have found them satisfactory for various analytical, experimental, and pharmaceutical operations. We have employed them chiefly in such evaporations as are performed for the residue only, or, at least, not for quantitative recovery of the distillate, in various evaporations of quantitative analysis, in the elimination of non-volatile alkaloids, in determining the organic matter in water, and in preparing fluid extracts. To evaporate at ordinary temperatures by hand-pump exhaustion is especially irksome in those cases when application of 125° to 150° F. is unobjectionable. And to connect a vessel under which heat may be applied with the air-pump involves quite as much labour as the arrangement of apparatus for exhaustion by condensation.

ON THE

ACTION OF CHLORIDE OF ZINC UPON CAMPHOR.

BY M. ADOLPH BOMMIER.

According to Gerhardt, when camphor is distilled over chloride of zinc, it changes into cymol and water, according to the following equation:—

$$C_{20}H_{16}O_2 = C_{20}H_{14} + 2HO.$$

MM. Lippmann and Longuinine,* Fittig, Koebrich, and Silke,† found great difficulty in preparing cymol from camphor, and observed during the reaction the formation of hydrocarbides homologous with benzol, which was also proved by ourselves upon repeating the experiment. Our experiments were made upon 2 kilos. of camphor, which when distilled four times over fused chloride of zinc, yielded about 700 kilos. of essence, which boiled at from 140° to 240°, and of which scarcely a tenth approached the boiling point of cymol. It was also ascertained that this essence, mixed with a solution of caustic potash, yields a product analogous to phenol. After precipitation by chlorhydric acid, 40 grammes were obtained, which, on distillation in a current of carbonic acid, yielded a small quantity of liquid, boiling below 200°, and the rest at a temperature somewhat higher. Here is the elementary analysis of this latter product:—

* *Bulletin de la Société Chimique*, Nouvelle série, tome vii., p. 374, 1867.
† *Ibid.*, tome x., p. 78, 1869.

	Experiment.	Calculation.
Carbon	76·87	77·77 (C_{12})
Hydrogen	8·13	7·40 (H_8)
Oxygen	15·00	14·83 (O_2)
	100·00	100·00

figures which correspond to cresylic alcohol.

The first was too hydrated for analysis; it was merely heated with oxalic and sulphuric acids, and the formation of rosalic acid proved characteristic of phenic alcohol.

These phenols have a slight but decided smell of phenic alcohol, whilst cresylic alcohol, obtained from tar, has a very disagreeable odour, being less easily purified than that obtained from camphor. Finally, in the reaction of chloride of zinc upon camphor, the formation of the sundry hydrocarbides and phenols shows that, contrary to what was believed, decomposition with deflagration ensued rather than simple dehydration, since if the experiment was carried on at a low temperature, the camphor distilled without alteration, whilst if the temperature was raised to the fusing point of the chloride of zinc, a still greater quantity of camphor remained unaltered even after four distillations.

ON ARTIFICIALLY-COLOURED WINES.

BY DR. T. L. PHIPSON, F.C.S.

When wine of any vintage is found to be wanting in colour, it is customary to mix it with a certain proportion of strongly-coloured wine grown in the South; for instance, with good Roussillon, &c. At Fismes and Poitiers, and probably in other parts of France, there exist, however, regular establishments where colouring matter for wines is manufactured on a somewhat extensive scale. And in Greece the flowers of the purple Holyoaks (*Althœa rosea*, *Malva arborea*, *Rose tremiere*) are collected for the like purpose to a considerable extent.

The material manufactured at Fismes is obtained from elderberry, both from the fruit of *Sambucus niger* and *S. ebulus*. The process is very simple. 250 to 500 parts of this richly-coloured fruit, with 30 to 65 parts of alum, and 600 to 800 of water, are the proportions generally employed. It has been stated that beet-root juice, blackberries, Brazil-wood, logwood, &c., are occasionally used, but, I believe, by no means so frequently as the substances above named.

Many methods have been tried in order to detect the presence of artificial colouring-matters in wines, but, it appears, with a very small amount of success. Œnocyanine may be precipitated from the wine, and its properties, studied with care, will show at once the presence of an adulterating material; but the process is rather long and delicate. I have shown, in a note on the "Absorption Spectra Yielded by Certain Organic Substances,"* that the pure colouring-matter of the grape gives no absorption bands, but only a general absorption, increasing gradually towards the violet; whilst the colouring-matter of the purple Holyoak, dissolved in water containing a little alum, gives a distinct and wide absorption band in the neighbourhood of D. This allows its presence in wine to be detected without much difficulty; and the same method applies equally well to the colouring-matters of logwood and Brazil-wood.

I have not yet ascertained how the colouring-matter of elderberry fruit affects the spectrum, but it is not difficult to discover in wine, according to M. Fauré, by means of gelatine. The fact is that œnocyanine is easily precipitated along with the tannin when gelatine is added to red wine, whilst other colouring-matters (and, among them, that of the elderberry) are left in solution. If there happen to be not enough tannin naturally present in the liquid to precipitate all the œnocyanine, a little more must be added.

Alum will be often found in wine which is artificially coloured; it vivifies the tint, and is supposed to preserve the wine. Its presence is not only highly injurious to the health, but will effectually prevent the ripening of wine and the development of the bouquet.

The test to which I have called attention may be made as follows:—Take a specimen of the wine to be examined, and, if its color is too powerful when examined in a thin tube by means of the prism, it must be diluted with distilled water until a proper degree of transparency is obtained. A minute quantity of alum is then added, and the specimen examined in the spectroscope. If an absorption band of any kind shows itself, the wine may be suspected.

Analytical Laboratory, Putney, S.W., Nov. 1st, 1869.

* *Journal of the Chemical Society*, Sept., 1869, p. 324.

THE CHEMISTRY OF THE BLAST FURNACE.*

BY I. LOWTHIAN BELL.

My attention has just been directed to a translation of an article in your journal by Mr. C. Schinz, of Strasburg, entitled "The Chemistry of the Blast Furnace according to Mr. I. L. Bell's Experiments." In a subject, the investigation of which is attended with so many practical difficulties as this, we can scarcely hope to discover the exact truth at once, and I think I can now amend—indeed, I may say, I have in a recent paper amended—to a small extent, the views communicated to my colleagues in the Chemical Society of London, in the paper of which the article in question is a criticism. I shall at all times be glad to have my opinions freely canvassed; but in the present instance Mr. Schinz has overlooked those minor parts of the inquiry in which I have probably erred, and attacks me in language a little more forcible than is perhaps strictly necessary upon matters where I hope to show the fallacy is all on his side.

In my discourse to the Chemical Society, I expressed a dissent from the view which maps out a furnace into zones of strongly defined dimensions, and gave my reasons, one of which was the irregularity of the size of the pieces introduced into its interior. Mr. Schinz says this mode of charging a blast furnace is a mistake often committed in England. I said nothing to the contrary; I am dealing with the effect, not with the cause, and leave the practical smelter to discover whether the saving in fuel by a different mode of procedure will pay for the expense incurred in its adoption. I have stated elsewhere† that where such an expensive fuel as charcoal is employed, more care *is* taken in this item than with us, but observation in almost every iron-producing

* Communicated by the Author simultaneously to the Chemical News and *Engineering*.

† Paper on our foreign competitors in the iron trade.

country in Europe enables me to challenge Mr. Schinz to name one instance where the approach to uniformity of dimensions in the materials is usually such as he would have us suppose.

The measurement of temperatures of the escaping gases of blast furnaces is assumed as being founded "upon a delusion;" because, as this gentleman observes, pieces of metals such as I employed laid on the bottom of the gas pipe, will, from their superior conducting power, not be melted by reason of their contact with the cold pipe, while ore exposed to the current of hot gases, will, from its less conducting power, acquire a temperature superior to that indicated by the non-fusion of the test metals. Now there is not one word in my paper to justify any such inference as to the mode followed in estimating the temperature of the gases; for it happens the specimens of ore operated upon in the experiments quoted were suspended by a thin rod on a tray 2 or 3 feet from the side of the gas pipe, and the metals intended to denote the temperatures were placed on the same tray (6 inches square), so that all must necessarily have been equally heated. Besides, Mr. Schinz might have given me credit for more care in obtaining my data, seeing I mention the use of three different kinds of pyrometer, not one of which could, without great difficulty, have been applied in the blundering way he suggests.

But, continues this chemist, if my observations as to temperature are true, "my conclusion" is still only delusively correct, "because reduction is accelerated by proportionate quantity of gas, by the amount of carbonic oxide such gas contains, and by its temperature." Before Mr. Schinz undertook to correct me, I had published an account of experiments* undertaken to show how these three conditions affect the rapidity and extent of reduction, but neither of these phenomena is in question in the present discussion. Former experimenters had given the results of their observations as to the temperature at which reduction *begins* in a blast furnace, and I gave the grounds for respectfully dissenting from opinions entertained by such eminent men as Tunner, Ebelmen, and Scheerer.

Mr. Schinz then proceeds to pass an opinion upon Tunner's analysis of the gases of the Wrbna furnace, which he says is "decidedly wrong," and then observes that the composition given of the gas of one of the Clarence furnaces is "just as false."

I may fairly leave the reputation of my friend, Professor Tunner, as a correct observer, to stand upon its own merits, and reserve my observations for pointing out to Mr. Schinz what is really involved in his somewhat gratuitous observation respecting the analysis of the Clarence gases. I quote the results obtained as they are given in my paper:—

Volumes in 100 Volumes. Hour of taking Sample. p.m.	CO_2 1st Trial.	CO_2 2nd Trial.	CO 1st Trial.	CO 2nd Trial.	N by Difference. 1st Trial.	N by Difference. 2nd Trial.
1.0	6·25	—	26·30	—	67·45	—
1.55	6·24	6·70	34·70	—	59·06	—
2.15	6·94	6·73	34·40	35·40	58·66	57·87
3.0	5·30	5·75	35·80	35·64	58·90	58·61
3.15	4·75	5·12	31·00	30·25	64·25	64·63
3.55	5·91	—	31·12	—	62·97	—
4.20	5·82	6·00	29·72	28·90	64·46	65·10
Average being	5·88	—	31·86	—	62·26	—

* Paper read at Middlesbrough meeting of Iron and Steel Institute, September, 1869.

Now, if the above figures had been obtained by an incompetent operator, one would have expected to have found discordant results upon the repetition of the analyses, and there being no evidence whatever of this, the word "false," used by Mr. Schinz, has, to my mind, a somewhat unpleasant sound.

To its application, however, I must submit, if this gentleman is correct in his assertion that furnace gas, having a composition like that given, is "almost impossible;" for he proceeds to show how, taking the nitrogen as the basis of his calculation, the quantity of oxygen, and hence of carbon, are incompatible with the ratio in which the first two elements exist in the atmosphere, having, of course, regard to the oxygen in the ore. In the estimate which has to prove how false my data are, Mr. Schinz assumes that the sole sources of oxygen are the blast and the ore, for he never gives a thought to the *limestone*. Now this is the less excusable, seeing that in the very next page in my paper, the theoretical composition of furnace gases is compared with that furnished by analysis, and the sources of each of the constituent parts are given, among which the limestone is distinctly mentioned. I shall not trouble you with all Mr. Schinz's figures, but content myself with giving a statement, by which it will be seen how nearly the analysis agrees with what the furnace was using at the time the gases were collected for the examination, assumed by this gentleman to be so incorrect.

The consumption for each ton of iron at the time was:—

	cwts.
Coke	29·50
Limestone, calcined, and containing about 22 per cent of carbonic acid	15·50
Ironstone	49·50
The coke contained of carbon	27·14
" " ash, moisture, &c	2·36
	29·50

The carbon which would be volatilised was:—

That contained in the coke	27·14
" " limestone partially calcined	0·93
	28·07
Less that to combine with the iron	0·74
	27·33

The gases of which the volumetric analysis is objected to by Mr. Schinz had the following composition:—

By volume.	By weight.	
CO_2 5·88	8·94	Carbon 15·65
CO 31·86	30·82	Oxygen 24·11
N 62·26	60·24	Nitrogen 60·24
100·00	100·00	100·00

From these proportions, the gases for each ton of iron will consist, by weight, of—

	Cwts.	Carbon.	Oxygen.
Nitrogen	105·20	—	—
Carbonic oxide	53·83 =	23·07	30·76
Carbonic acid	15·61 =	4·26	11·35
	174·64	27·33	42·11

Thus, then, 42·11 cwts. of oxygen are associated with the 27·33 of carbon set out with as having been volatilised. For this we have oxygen accompanying the nitrogen found

[English Edition, Vol. XX., No. 520, pages 233, 234.]

	cwts.
in the gases, which would be—105·20 × $\frac{3}{7}$	31·42
The iron in 20 cwts. of pig is 19 cwts., which, as peroxide, is equal to oxygen	8·14
Oxygen combined with 0·93 carbon in the carbonic acid of limestone	2·48
	42·04

instead of 42·11, which will probably be accepted as a nearer approximation to truth than the words "almost impossible" would seem to convey.

The actual numbers objected to by Mr. Schinz were CO_2 6, Co 32, N 62, which was merely the volumetric composition of a mixture made for the purpose of comparing its effect in deoxidising iron ore with that of a second mixture, made to resemble the gases of the Wrbna furnace. These numbers, it will be perceived, closely resemble the analysis just examined.

This omission of limestone, as contributing to the constituents of the furnace gases, is repeated by Mr. Schinz when he examines my comparison of the gases produced by the use of hot and cold air in Wales, neither of which, it is expressly stated, were analysed, but assumed as resembling those of the Clarence Works for the sole purpose of estimating the quantity of heat carried off by their means.

In these instances, the gases were considered as consisting, by weight, of CO_2 9, CO 32, N 59; numbers which differ but slightly from those deduced from the analysis of the Clarence gases, as formerly stated.

I find I have made two errors in the calculation based on this assumption. The weight of gases from the cold blast

	CO_2.	CO.	N.	HO_2	Total.
furnace should be....	18·20	64·70	119·40	3·93	206·23
instead of, as formerly	18·19	64·73	124·60	3·93	211·45
and from the hot blast it should be.....	13·50	48·10	88·60	3·06	153·26
instead of, as before..	12·94	46·22	92·73	3·06	154·95

The difference, however, between these two sets of figures is so small as not materially to affect the conclusions drawn from them; but Mr. Schinz arrives at a very contrary opinion by changing the weight of nitrogen, given above in the case of the cold blast furnace, from 124·6 to 142·6, and, not satisfied with this mistake, commits another in the arithmetic used in working out the result from the hot blast furnace, by which he makes the ratio of the volumes of carbon vapour and oxygen per 100 volumes of nitrogen to be 35·82 of carbon and 41·22 of oxygen instead of 29·4 and 33·8 respectively.

In alluding to my remarks on the hot blast, Mr. Schinz (*àpropos* of nothing I said) mentions that, "with cold blast an increase of fuel will always yield a product richer in carbon graphite, whilst an increase of temperature by means of the hot blast will never secure the same success." All I can say is the experience of twenty-five years with blast furnaces and that gained by a constant study of a present annual make of 120,000 tons of iron has produced no such impression on my mind. Neither am I disposed to accept as a "solution of the problem relating to the wonderful effect of the hot blast," Mr. Schinz's explanation, who considers solid carbon and not carbonic oxide as the reducing agent.

If my experiments are "worthless," the calculations of Mr. Schinz are not of a very accurate order, for he founds an estimate of heat units supplied to a furnace on the assumption that 113 kilos. of carbon require 3881 kilos. of air for conversion into carbonic oxide, whereas it ought to be 655 kilos., and equally so is his calculation which proves hot blast iron to require more fuel than that smelted with cold air.

I am censured, too, for not being able to distinguish between height and capacity in referring to the economy in fuel effected by a change in the dimensions of blast furnaces. My language may be defective in clearness, but it seemed to me that when I stated that the Lilleshall furnaces saved coal by an addition of 21 ft. to their height, none but a very fastidious critic could have imagined this alteration in form to have been made without their capacity having been increased to a corresponding extent.

There is little in Mr. Schinz's review of my work I am disposed to assent to, but I am unwilling to trespass further on your space, which I have been induced to do at some length in order that the Fellows of the Chemical Society, who honoured me by an invitation to give an address on applied chemistry, should not think I had complied with their request in the negligent manner this gentleman would have them believe.

Washington, Durham.

FLUX FOR BLOWPIPE ANALYSIS.

BY PROFESSOR HOW, D.C.L., WINDSOR, NOVA SCOTIA.

Under the heading given above, the Chemical News last year (vol. xviii., p. 203; *Amer. Repr., Dec.*, 1868, *page* 323) reprinted a note by Mr. S. D. Poole to the *Scientific American* on the advantages of a mixture of selenite and fluor over the well-known flux of bisulphate of potassium and fluor devised by Turner as a reagent for producing coloured flames before the blowpipe, and over selenite alone as an addition to silicates, recommended by Fresenius. Mr. Poole's objection to the former is the intense violet tint given to the flame by potassium, and to the latter, its infusibility and want of decomposing power. This reagent, he says, "forms an easily fusible bead, which by itself gives only a very faint dull red tint (lime) to the flame, but which renders the presence of such elements as give colour most beautifully evident and characteristic."

My present object is to point out that the newly proposed flux is of more limited applicability than that of Turner, because there is no provision in it for the liberation of hydrofluoric acid. In testing for boracic acid *e.g.*, it fails completely to give the green flame with natroboro-calcite and with borax, whereas Turner's flux gives a distinct reaction in each case. When silica is present in minerals along with much boracic acid, the addition of either of these fluxes is superfluous; thus with silicoboro-calcite a fine green—not yellowish green—is obtained with the mineral alone. Sussexite gives a yellowish green colour alone, and the addition of Poole's flux seems to me to obscure the reaction, while Turner's gives a fine green flame. As regards some other colouring elements, when colour is given by minerals alone, the best colour is obtained without the new flux; this is the case with celestine and strontianite. When silica is present, the test answers well in some instances, as with lepidolite and spodumene, and especially, as Mr. Poole states, with the felspars in which K and Na exist alone or predominate respectively. I may mention that small quantities of boracic acid which escape detection by using even Turner's flux, may be discovered in minerals soluble in HCl by repeated wetting and drying of the turmeric paper.

SUPERSATURATION, SURFUSION, AND SOLUTION.

BY M. DUBRUNFAUT.

Supersaturation is evidently a badly-defined phenomenon of solution; and a study of these phenomena is the only way of ascertaining the cause of supersaturation.

The interesting labours of M. Gernez, animated by the beautiful experiments of M. Pasteur, have established, in the most complete manner, the active part invariably played by the crystal which causes a cessation of the state of supersaturation in similar or isomorphous crystals. This proves the existence of a special power in the crystals themselves, varying in its mode of being according to their chemical and geometrical formation. But the labours of M. Gernez end here; they show, in fact, in the case of sulphate of soda, for instance, the generalisation of the long-known property possessed by a crystal of sulphate of soda of causing a supersaturated solution of the same salt to instantly assume the form of a crystalline mass. Nothing, however, of the cause of this fact, or of its relation with the condition of supersaturation, has been explained.

M. Loewel has fully proved, with regard to the supersaturation of sulphate of soda,* that the salt dissolved as the compound $SO_3NaO.10HO$ is found in solution in the state of $SO_3NaO.7HO$. The experimental demonstration of this fact appears to be the result of the exact analysis of crystals formed simply by lowering the temperature of the supersaturated liquid. The dissolved salt which is thus brought into a state of supersaturation changes its nature, or, at least, its molecular constitution. It now becomes a totally different product, possessing other properties, and that which is considered as supersaturation of the primitive product is really, in the new substance derived from it, merely a normal saturation; in other words, sulphate of soda is dissolved in water in the proportion of 10 equivalents of the latter, and, upon overcharging the solution with an excess of the salt, its composition is modified in such a manner as to create a new and more soluble product, consequently susceptible of producing that apparently strange phenomenon called supersaturation.

This interpretation of the facts relating to supersaturation does not detract the rules of the experimental method; and, by developing its logical consequences, the theory may be generalised and applied to all cases of solution, even to those not possessing the characteristic properties of supersaturation.

If it be certain (as we admit) that the sulphate of soda, with 10 equivalents of water, exists in the so-called supersaturated solution, with the molecular composition characterised by 7 equivalents HO, it is none the less true that, under certain known conditions, the composition of the salt may return to its primitive condition, which clearly proves, in the dissolved sulphate of soda, an unstable and fugitive molecular condition, which any accident or untoward circumstance may alter or destroy. This is what happens, in fact, under the influence of a crystal similar to sulphate of soda with 10 equivalents of water, or of an isomorphous salt; and, in this case, the return of the salt to its primitive composition is accompanied by a thermic manifestation, which confirms the change, such as may be noticed in amorphous allotropic changes, and in those of substances which crystallise in two shapes.

The modifications which matter presents in solution are confirmed, under another form, by the fact of double molecular rotation, which has been observed in crystallisable glucose, lactine, and their derivatives. In these cases, the crystallisable substances evidently contract the molecular constitution which they display at the moment of solution from the power of crystallisation, and it lasts sufficiently long to be quite perceptible. In the case of crystallised glucose, the transition of bi-rotatory to the state of mono-rotatory glucose requires, at a low temperature, four or five hours for completion.

This property is not perceptible in all molecularly-active substances, but it is believed to be general and proper, not only to all substances possessing the molecular property, but to all soluble substances whatsoever.

It is, therefore, highly probable that all soluble, crystallisable, or amorphous bodies have, when in solution, a different molecular constitution to that possessed by them when in a solid condition. This modification, as is proved by supersaturation and double rotation of glucose, is only ephemeral, and depends upon the particular condition of the substance in solution, and perhaps, also, on the nature of the solvents; it ceases when the causes which produce it are removed.

Thus it is retained by crystallised glucose in its crystalline state, whether its constitution be $C_{12}H_{12}O_{12}$ or $C_{12}H_{11}O_{14}$; but the moment that the crystal becomes liquefied, either by melting or by any kind of solvent, its molecular constitution, displayed by its rotatory power, is changed, and can only be regained by a return to the solid condition. Thus all known facts relating to supersaturation and surfusion may be explained without the necessity of distinguishing these different conditions of matter by the physical causes which annul them.

Solution, regarded thus, enters into the category of known chemical forces, which modify, in a regular and invariable manner, the arrangement of elements in integrant molecules.

After a careful examination of osmotic analysis as applied to complex saline solutions, I find that it is impossible to agree that diffusibility, which is, as we have demonstrated, the vehicle of this mode of analysis, occurs when the substance in question is in a solid state; on the contrary, everything goes to prove that the elements of the current of exosmose which produce the analysis are derived from a fraction of the solvent charged with the diffusible product. If this were not so, it would be difficult to account for what passes in my methodical analysis of molasses, in which the diffusion of sugar is constant at every period of the analysis, whilst the diffusion decreases geometrically in proportion as the analysis reaches its termination.

It certainly must be admitted that, in a solution of sundry salts, possessing different physical and chemical properties, each salt takes and retains, even in the complex solution itself, that contingent of the solvent assigned to it by its special qualities. It is upon these molecular liquid groups, which are more or less defined in every medium, that the force of diffusion is exercised which acts in so evident a manner in all cases of endosmotic analysis.

Here is another important fact in molecular physics which has been confounded by experimentalists with those of supersaturation.

When a crystallisable substance, such as sugar, is

* M. Gernez, who has studied this subject with care, attributes the priority of the observations in question to foreign observers; but M. Loewel has also worked them out in a much better manner, without having previously heard of them, and therefore deserves the credit of an original discovery.

extracted from its solution in water by very strong alcohol, two different cases may arise, according to the conditions of the experiment, in which the sugar remains for a moment in a state resembling the phenomenon known as supersaturation, but which really differs from it essentially, or the sugar is precipitated in viscous lumps resembling precipitates formed under the same conditions by gum, dextrine, &c.

Upon examining this precipitate with a microscope, an amorphous or globular texture is easily observed, and these products float in the alcoholic solution. After a certain time, the viscous precipitate is transformed into well-defined prismatic crystals of sugar. These facts appear frequently, if not always, under the experimental conditions specified by M. Margueritte—to separate sugar from molasses by means of alcohol and sulphuric acid. This effect has been confounded with the known phenomenon of supersaturation. Under these conditions, alcoholic solutions said to be exclusively supersaturated furnish their contingent of sugar without change of density, which proves that all the sugar obtained was the result of amorphous sugar. Is not this transitory state of the sugar shown by the action of the alcohol on the dissolved sugar, the normal condition of sugar modified by solution? and is not this experiment a fresh proof in support of my mode of considering the phenomena of solution and supersaturation?

Is not that particular state of matter to which Mr. Graham has given the name of *the colloid condition*, a transitory and ephemeral condition analogous to that to which I have just called attention with regard to crystallisable sugar, and which is common to a number of other substances soluble and crystallisable from alcohol? —*Comptes Rendus.*

MODIFICATION OF THE METHODS FOR THE

VOLUMETRICAL ESTIMATION

OF THE

QUANTITY OF COPPER AND ZINC CONTAINED IN ORES,

BY MEANS OF A STANDARD SOLUTION OF FERROCYANIDE OF POTASSIUM.

BY M. MAURIZIO GALETTI,

CHIEF ASSAYER AND CHEMIST OF THE ROYAL ASSAY OFFICE AT GENOA.

When the ores of copper or zinc, after having been acted upon by acids, are treated with excess of ammonia in order to precipitate the oxide of iron, that substance invariably retains larger or smaller quantities of the oxides of the metals just named. The quantity thereof so retained varies according to the larger or smaller quantity of copper and zinc contained in the ores. It is hence necessary to repeat the treatment with ammonia at least twice, sometimes even three and four times, in order to obtain a complete separation of copper or zinc from the iron.

In order to obviate the loss of time which is caused by these operations, the author proposes to convert into acetates the small quantities of the oxides of copper and zinc which accompany the precipitate of oxide of iron. This can be effected by two different methods, dependent on the fact whether the oxide of iron is removed by filtration (previous to the use of standard solution of ferrocyanide of potassium), or is left in the ammoniacal liquid. The operation is conducted as follows:—

Suppose a copper pyrites to be submitted to analysis. Take 1 grm. of the previously very carefully pulverised and dried ore. Treat it first with concentrated nitric acid, boiling to incipient dryness, in order thereby to free the sulphur from any small particles of ore which are at first taken up by it. Add 10 c.c. of hydrochloric acid, boil down to about half that bulk, dilute with distilled water, and next add ammonia in large excess; boil the fluid, and next add pure acetic acid (sp. gr. 1·070) until the liquid assumes an emerald-green colour. After the liquid has been well stirred up, boil again for about two minutes; then add again ammonia in excess. The liquid is then poured out of the flask into a suitable glass vessel, and the flask is rinsed out with a sufficient quantity of distilled water to bring the bulk of the fluid up to ½ litre. This having been done, the fluid is very cautiously and gradually acidified with very dilute acetic acid, 1 part of the acid just alluded to, and 10 parts of distilled water. Any large excess of this acid should be avoided; the fluid should only be very slightly acid. As soon as the basic acetate of iron has subsided, the precipitation of the copper by means of the standard solution of ferrocyanide of potassium is proceeded with.

Since the oxide of copper which might have adhered to the oxide of iron has been converted by the process just described into a soluble salt, it cannot fail to be completely precipitated by the ferrocyanide of potassium solution. When a determination of copper has to be made in ores which are rather poor (that is to say, contain less than, or up to, 6 per cent of copper), it is preferable to add to the nitric acid solution 0·1 grm. of pure copper, which quantity has to be deducted afterwards from the results obtained. This precaution is required in order to prevent the presence of a large quantity of oxide of iron from vitiating the results of analysis of poor ores. When ores contain up to 12 per cent of copper, a quantity of 1 grm. of the ore should be taken; but, for richer ores, 0·5 grm. is sufficient. It is always advisable to make a control analysis with pure copper at the same time while testing the ores.

The second modification is carried out in the following manner.

After the second addition of ammonia to the liquid, it is filtered, and the precipitate is washed with a dilute and boiling solution of acid acetate of ammonia. This solution is prepared by saturating 20 grms. of pure acetic acid with ammonia, and addition thereto of 15 grms. of pure acetic acid in 585 grms. of water. When the washing of the oxide of iron is carefully done, the salt of copper, which tenaciously adheres to the oxide of iron, is entirely removed therefrom; but it will require about 400 grms. of the fluid, the preparation of which has just been described.

The normal solution of copper should be treated as follows.

A quantity of 0·2 grm. of pure copper is dissolved in nitric acid; excess of ammonia is added; the fluid next acidified with acetic acid, thereupon diluted with 400 grms. of acid acetate of ammonia, and the whole brought up to 500 grms. To this solution 20 c.c. of the standard solution of ferrocyanide of potassium are added, and, after the necessary corrections have been made, the liquid must not contain any more excess of either copper or of ferrocyanide.

The standard solution of ferrocyanide of potassium

to be used for the determination of copper is made by dissolving 50·225 grms. of ferrocyanide in as much distilled water as will suffice to make the solution weigh exactly 1 kilogramme.

The ferrocyanide solution destined for the estimation of zinc is made by dissolving 41·250 grms. of the said salt in the same quantity of water.

If it should happen that the copper ores contain zinc, nickel, and cobalt, the copper should be first separated from these metals, either by precipitating the copper from its solution in acid by means of zinc, or as sulphide of copper by means of hyposulphite of soda.

Zinc ores are treated in the very same manner as just described for copper ores. When sulphuret of zinc (the "black-jack" of English miners) is to be operated upon, care should be taken that, after the addition of hydrochloric acid, the fluid should be sufficiently far evaporated as to insure the expulsion of all nitric acid. Since zinc ores are usually rather rich, ½ grm. is sufficient for analysis. Calamine-stone (native carbonate of zinc) should at once be acted upon with hydrochloric acid; but, in order to make sure of the complete oxidation of all the iron the ore may happen to contain, it is best to add to the acid a few decigrammes of pure chlorate of potassa. After having suffered this solution to boil for a few minutes, it is diluted with distilled water; a large excess of ammonia is added to the solution, and it is next treated as above-described for copper.

The author states that he has convinced himself, by a set of experiments instituted on purpose, that the presence of compounds of lead (as, for instance, carbonate, sulphate, and sulphide of lead) occurring along with the ores of zinc, does not interfere with the correctness of the complete precipitation of zinc as ferrocyanide of zinc. This even holds good up to 10 per cent of metallic lead, a quantity which does not, also, interfere when mixed with copper ores.

Since some ores of zinc, especially calamine-stone, may, and often do, contain manganese, it is best to add to the ammoniacal solution, before any acetic acid is added, a few drops (from 2 to 4) of bromine, in order to convert thereby the protoxide of manganese into proto-sesquioxide, leaving the solution standing for twenty-four hours after the addition of the bromine.

Since the ammoniacal solution of chloride of zinc is colourless, there should be added to it, previous to the very cautious acidification by means of dilute acetic acid, a few drops of tincture of litmus, in order to more readily hit the precise point of sufficient acidification, to be exhibited by the blue colouration changing to a rose-red.

When iron is present, the same precautions are to be observed as described under copper.

The ferrocyanide of zinc which is mixed with oxide of iron preserves its naturally white colour as long as the liquid yet contains free zinc, but its colour changes to a greyish white as soon as a very slight excess of the ferrocyanide standard solution is present; the liquid then also becomes turbid, and the precipitate settles very slowly. By these constantly occurring and quiet characteristic signs, the end of the operation may be always recognised. In order to make sure, the liquid should be stirred up with a glass rod which has been just previously moistened with an acidified and dilute solution of ammoniacal nitrate of copper, which will have the effect of indicating any excess of the ferrocyanide solution, by exhibiting the more or less intense colour characteristic of ferrocyanide of copper. The zinc solution should be at a temperature of from 40° to 50°, whereby the rapid precipitation and subsidence of the ferrocyanide of zinc is promoted.

When filtration is avoided, the presence of the gelatinous silica (due to the decomposition of silicates of zinc occurring in the ores of that metal, and brought to a gelatinous condition by the treatment of such ores with hydrochloric acid) does not interfere with the correctness and good results of this method of estimating zinc quantitatively in its ores.

It is gratifying to learn that, since the discovery of extensive and very valuable zinc ore deposits (calamine-stone) in the island of Sardinia, and the demand for this ore created in England, France, Belgium, and Rhenish Prussia, a committee of analytical chemists from these countries have, after having previously made themselves fully acquainted with the method of analysis of zinc ores just described, unanimously resolved to estimate the zinc (to be brought under contract to each of the countries just named from Sardinia) by the method here described, as being the best suited for the purpose.—*Zeitschrift für Analytische Chemie.*

ON A NEW CHROMIUM OXYCHLORIDE.*

BY T. E. THORPE, PH.D.,

ASSISTANT IN THE LABORATORY OF OWEN'S COLLEGE.

When chromyl dichloride $CrO_2 \left\{ \begin{matrix} Cl. \\ Cl. \end{matrix} \right.$ prepared by heating a mixture of potassium dichromate, sodium chloride, and sulphuric acid, is maintained at a temperature of 180° C.—190° C. in a sealed tube for three or four hours, it is almost completely converted into a black solid substance, and on opening the tube when cold a considerable quantity of free chlorine escapes. By exhausting the tubes containing the liquid chloride before subjecting them to heat, I have ascertained that chlorine is the only gaseous product of this decomposition. The black compound invariably contains more or less of the liquid chlorine which has escaped decomposition: the greater part of this is easily expelled on gently heating the mass after opening the tube. In order to free it completely from the latter body, the black substance was transferred to a clean tube and heated to 120° C. (*i.e.*, about 2° above the boiling point of chromyl dichloride) in a current of dry carbonic acid gas until its weight appeared constant. The following determination of the amount of chlorine contained in the volatile portion shows that it is simply chromyl dichloride which has remained undecomposed.

0·8741 grm. liquid chloride gave 1·6458 grms. silver chloride.

Calculated for CrO_2Cl_2.	Found.
45·7 per cent.	46·5 per cent.

The solid substance dried in the manner above described appears as a black anerystalline powder, which when exposed to the air rapidly deliquesces to a dark reddish brown syrupy liquid which smells of free chlorine. When thrown into water it quickly dissolves, forming a dark brown solution, which on standing also evolves chlorine. In nitric acid solution hypochlorous acid appears to be produced. In strong hydrochloric acid the substance dissolves with a dark brown colouration, and on boiling the solution, chlorine is evolved, the liquid

* Read before the Manchester Literary and Philosophical Society, November 2, 1869.

becomes greenish yellow, and ultimately changes to the dark green colour peculiar to a solution of chromium sesquioxide in hydrochloric acid. When thrown into dilute ammonia, chromic acid is dissolved, together with all the chlorine, and a precipitate is formed possessing the properties of the chromate of chrome sesquioxide ($Cr_2O_3CrO_3$) described by Storer and Eliot. Upon this decomposition is based the method which I have employed for the estimation of the amount of chloride contained in this body. The weighed quantity of the substance was treated with very dilute ammonia, the solution boiled for a few minutes, filtered, the precipitate well washed by hot water, an excess of nitric acid added to the filtrate, and the chlorine precipitated by the addition of silver nitrate. Two determinations of chlorine carried out in this manner on preparations made at different times gave the following results:—

Preparation I.
0·5900 grm. substance gave 0·4870 grm. silver chloride and 0·0069 grm. metallic silver.

Preparation II.
0·493 grm. substance gave 0·4250 grm. silver chloride.

Prep. I.....20·80 per cent Cl.
Prep. II.....21·32 " "

Mean.....21·06

In order to determine the amount of chromium it contains a weighed portion of the substance was repeatedly heated with strong hydrochloric acid on a water-bath until the evolution of chlorine entirely ceased; the solution was then diluted with water, heated to boiling, ammonia added in slight excess, and again boiled until the supernatant liquid appeared perfectly colourless. The precipitated chrome sesquioxide was then filtered, dried, and weighed.

Preparation I.
0·3442 grm. substance gave 0·2470 grm. chrome sesquioxide.
0·5900 grm. substance gave 0·4235 grm. chrome sesquioxide.

Preapration II.
0·5082 grm. substance gave 0 3590 grm. chrome sesquioxide.
0·5942 grm. substance gave 0·4210 grm. chrome sesquioxide.

Prep. I. 49·30 per cent Cr.
49·25 " "
Prep. II. 48·45 " "
48·62 " "

Mean.....48·91

Hence the percentage composition of the substance is as follows:—

	Found.	Ratios.	Calculated.
Chlorine.....	21·06	2	21·86
Chromium.....	48·91	3	48·54
Oxygen.....	30·03	6	29·60
	100·00		100·00

I have attempted to control the above empirical formula ($Cr_3O_6Cl_2$) by heating a weighed portion of the substance in hydrogen. The action of hydrogen upon the new chloride when heated is extremely energetic. At a comparatively low temperature it takes fire, combustion proceeds rapidly throughout the mass, and ultimately the substance is converted into chrome sesquioxide, hydrochloric acid, and water. Care must be taken to regulate the current of the hydrogen, since, if too rapid, particles of the finely divided sesquioxide are apt to be mechanically carried away. From an experiment, in which the gas was carefully purified from oxygen by passing it through strongly alkaline pyrogallate solution and over heated metallic copper, and then dried by transmitting it through tubes containing pumice moistened with strong sulphuric acid, the following numbers were obtained:—

0·8715 grm. substance gave 0·6150 grm. chrome sesquioxide.

Found 70·58 per cent Cr_2O_3,
$Cr_3O_6Cl_2$ gives by calculation 70·72 per cent.

I had an additional object in thus studying the action of hydrogen upon the new chloride. I considered that this action might, possibly, throw some light on the constitution of this compound. The new oxychloride may, in conformity with the analytical results, be regarded as a compound of chromous chloride with two equivalents of chromium trioxide. Now, chromous chloride, according to Moberg, may be heated in hydrogen to the softening point of glass without suffering decomposition, and if it were found that water was the only volatile product of the reaction, we should possess a certain amount of evidence for supposing that the formula $CrCl_2,2CrO_3$ represents the constitution of this substance. Experiment showed, however, that the chlorine was not so firmly united in this compound as in the chromous chloride: on gently heating the substance in hydrogen, hydrochloric acid was immediately evolved.

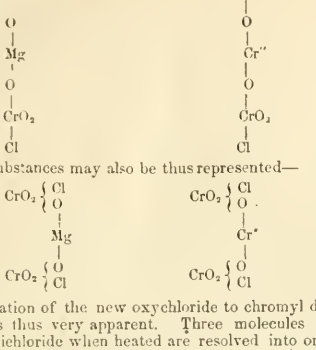
Péligot has described a series of salts to which are assigned the general formulæ MCl, CrO_3 and $M''Cl_2,2CrO_3$, where M represents a monovalent metal and M'' a divalent metal. The following are the names and formulæ of the salts prepared by Péligot.

KCl,CrO_3.....Potassium chlorochromate.
$NaCl,CrO_3$.....Sodium chlorochromate.
NH_4Cl,CrO_3.....Ammonium chlorochromate.
$MgCl_2,2CrO_3$.....Magnesium chlorochromate.
$CaCl_2,2CrO_3$.....Calcium chlorochromate.

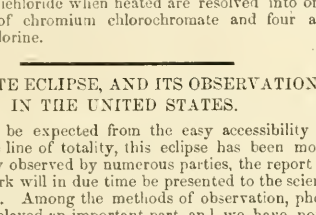
Now the new oxychloride stands in a very evident relation to these compounds. Supposing, for a moment, that the formulæ given to these substances correctly represent their constitution, then the new oxychloride may be regarded as the chromium term of the series—divalent chromium replacing magnesium or calcium.

$$Cr''Cl_2,CrO_3,$$

a formula identical with that of which I have just attempted to show the impropriety. But there is still another reason for supposing that a compound thus constituted could not exist. Chromous chloride is one of the most energetic deoxidising agents known, and we can hardly conceive it to be united in a stable compound with a substance which so readily parts with its oxygen as chromium trioxide. Hence I am disposed to regard the constitution of the salts of Péligot as very different from that implied by the above method of representation: indeed, to the best of my knowledge, the general formula assigned to these salts expresses not a single experimental fact, unless it be the mode of their decomposition by water; probably it had reference to the views of Rose and Berzelius respecting the constitution of the so-called chlorochromic acid. The following structural formulæ better represents, in my opinion, the constitution of these compounds and their relation to chromyl dichloride.



These substances may also be thus represented—



The relation of the new oxychloride to chromyl dichloride is thus very apparent. Three molecules of chromyl dichloride when heated are resolved into one molecule of chromium chlorochromate and four atoms of chlorine.

THE LATE ECLIPSE, AND ITS OBSERVATIONS IN THE UNITED STATES.

As might be expected from the easy accessibility of the entire line of totality, this eclipse has been most thoroughly observed by numerous parties, the report of whose work will in due time be presented to the scientific world. Among the methods of observation, photography played an important part, and we have now before us an admirable series of views obtained by a large party organised and conducted by Dr. Henry Morton, Professor of Chemistry in the University of Pennsylvania, whose communications have sometimes appeared in our columns.

These pictures show, in the first place, very fine definition in the telescope employed, as the roughness or mountainous character of the moon's edge is clearly given in the pictures of partial phase, as well as the sun-spots and surrounding faculæ.

Thus, Professor A. M. Mayer, who took charge of one of the three sections of Professor Morton's party, has shown, by measurement on the photographs, a change of shape in one of the larger spots during the eclipse, amounting to a motion of 2000 miles in its edges.

During totality, no less than thirteen negatives were secured, showing a large number of prominences, some massive and others delicate, as well as radiant brushes of a softer light, such as have been before seen, but never as yet photographed. By another of the sections of this large party, besides similar pictures to the above, one was obtained showing the curious phenomena known as Bailey's beads.

The time of exposure determined by Professor Mayer for the partial-phase pictures was the 1-500th of a second. Those taken during totality were exposed from five to sixteen seconds.

The *Journal of the Franklin Institute* for September has sixteen pages devoted to Professor Morton's report of his expedition to Professor J. H. C. Coffin, U. S. N., Supt. of the *Nautical Almanack*, under whose authority this and other expeditions were organised, with an admirable photograph from one of the totality negatives, and several woodcuts.

One of these, showing the general character of the prominences, we here give.

The line A B represents the direction of a parallel of declination; C D a declination circle. F E is the moon's path from first contact at F. The prominences are here all shown at once; although, of course, those on the sun's eastern limb alone were seen at first, those on the west side only at the end of the totality.

In the October number of the same journal, of which advanced sheets have been sent us, thirty-eight pages are devoted to the reports to Dr. Morton of those in charge of the various departments. From these we extract some of the most interesting portions as follows.

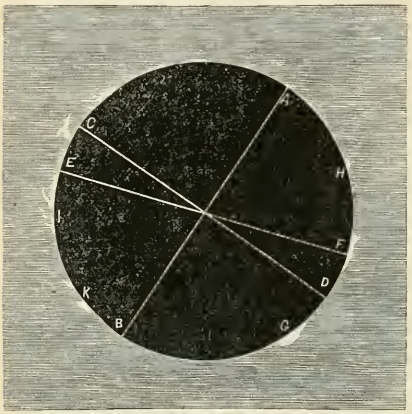
Photographs of the Chromosphere.

Dr. B. A. Gould writes:—An examination of the beautiful photographs made at Burlington and Ottumwa by the sections of your party in charge of Professors Mayer and Himes, and a comparison of them with my sketches of the corona, have led me to the conviction that the radiance around the moon in the pictures made during totality is not the corona at all, but is actually the image of what Lockyer has called the chromosphere.

This interesting fact is indicated by many different considerations. The directions of maximum radiance do not coincide with those of the great beams of the corona; they remained constant, while the latter were variable. There is a diameter approximately corresponding to the solar axis, near the extremities of which the radiance upon the photographs is a minimum, whereas the coronal beams in these directions were especially marked during a great part of the total obscuration. The coronal beams stood in no apparent relation to the protuberances, whereas the aureole, seen upon the photographs, is most marked in their immediate vicinity; indeed, the great protuberance, at 230° to 245°, seems to have formed a southern limit to the radiance on the western side, while a sharp northern limit is seen on all the photographs at about 350°, the intermediate are being thickly studded with protuberances which the moon displayed at the close of totality. The exquisite masses of flocculent light on the following limb are upon the two sides of that curious prominence at 93°, which at first resembled an ear of corn, as you have said, but which, in the later pictures, after it had been more occulted, and its southern branch thus rendered more conspicuous, was like a pair of antelope horns, to which some observers compare it. Whatever of this aureole is shown upon the photographs was occulted or displayed by the lunar motion, precisely as the protuberances were. The variations in the form of the corona, on the other hand, did not seem to be dependent in any degree upon the moon's motion.

The singular and elegant structural indications in the special aggregations of light on the eastern side may be of high value in guiding to a farther knowledge of the chromosphere. They are manifest in all the photographs by your parties which I have seen, but are especially marked in those of shortest exposure, such as the first one at Ottumwa. In some of the later views, they may be detected on the other side of the sun, though less distinct; but the very irregular and jagged outline of the chromosphere, as described by Janssen and Lockyer, is exhibited in perfection.

This happy result is clearly attributable to the relative shortness of the time of exposure, by which the highly photographic rays of the chromosphere have depicted themselves, without obliteration by the mass of coronal light which veiled them from the eye. Let us hope that, at the next total eclipse, some impressions may be taken with an exposure not exceeding a single second. The inference seems warrantable, that, in this way, better than in any other, the internal structure of the protuberances may be exhibited, though other phenomena may fail to record themselves.



You will observe that some of the brighter, petal-like, flocculi of light have produced apparent indentations in the moon's limb at their base, like those at the bases of the protuberances. These indentations are evidently due to specular reflection from the moon's surface, as I stated to the American Association at Salem, last month. Had any doubt existed in my mind, previously, it would have been removed by an inspection of the photographs.

Abstract of Professor Young's Report.

The observer was a member of the party under the direction of Professor J. H. C. Coffin, of the *Nautical Almanac* Office, stationed at Burlington, Iowa.

The instrument employed was a spectroscope with 5 prisms of 45° each, having faces $2\frac{1}{4}$ by $3\frac{1}{4}$ inches; the collimator and telescope had apertures of $2\frac{1}{4}$ inches, with a focal length of 17. These were connected with a "comet seeker" of 4 in. aperture and 30 in. focus, used with an eye-piece, and giving an image of the sun, $2\frac{1}{2}$ inches in diameter, on the slit of the spectroscope. A graduated screen at the slit determined positions of points on the sun's limb, and a wire micrometer measured the positions of spectrum lines. The whole was mounted equatorially with slow motion screws.

Protuberances were noted before the eclipse at + 85° to 100°, large and not very bright; at + 146°, small and bright. The photographs show another at 155°, which escaped notice; also at − 70° to 80° low, but pretty bright; and at − 130°, very large and bright, the principal one. Angles are reckoned on the sun's limb from the North point, + towards the East, − towards the West.

The first contact was observed by watching the gradual shortening and final extinction of the *bright line*, c, in the spectrum of the prominence, which happened to be at the point of contact. The moon's approach was perceived full thirty seconds before its actual appulse; the observation was perfectly easy, and the time determined is certainly to be relied on within half a second, and probably much less. The presence of a prominence at the point of contract is not essential to the success of the method, as there is everywhere on the sun's limb sufficient depth of chromosphere to answer the purpose.

It is proposed to apply the spectroscope to observations both of the external and internal contacts at the next transit of Venus.

During the totality, the following nine bright lines were observed in the spectrum, viz., c, dazzling in brilliance; 1017·5 (near D, the numbers refer to Kirchhoff's scale,) very bright, but not equal to c; 1250 ± 20, very faint, position only estimated; 1350 ± 20, like the preceding; 1474 (a little below E.) conspicuous, but not more than half as bright as 1017·5; F, next to c in brightness; 2602 ± 2, a little fainter than 1474, position determined by micrometrical reference to the next; 2796, a little below c, the well known $H\gamma$ line in brightness between 1017·5 and 1474; and finally *h*, or $H\delta$, somewhat brighter than 1474. *b* was not seen, it is supposed, on account of a mistake in carrying that portion of the spectrum through the field while there was no prominence on the slit.

* The line 1474 was recognised as belonging to the *spectrum of corona*, in the first place, by its extending clear across the spectrum, while 1017 did not, and then by its remaining visible when the slit was moved away from the protuberance, while the other lines (c and 107) disappeared. The impression of the observer is that faint lines 1250 and 1350 behaved in the same manner, but his recollection as to this point is not very certain.

These three lines, 1250, 1350, and 1474, coincide far within the probable errors of observation with three lines observed by Prof. Winlock in the spectrum of the Aurora Borealis. The first two are not accurately enough determined, in position, to allow much stress to be put upon any apparent coincidences on their part, but the last is perfectly well known, and its exact agreement throughout with one of the fainter lines of the Aurora, when combined with the general appearance of the Corona and other considerations, give a good deal of probability to the conjecture that *our Aurora Borealis and the Solar Corona are identical phenomena.*

The line 1474 is given by both Kirchhoff and Angström (not by Huggins, who, however, omits many faint lines,) as belonging to the *iron* spectrum, and this

* A careful examination of the photographs of the promiences on the eastern limb of the sun, upon which the slit of the spectroscope was directed during the first half of totality, somewhat diminishes my confidence in the conclusion of the text, as to the nature of these three lines. I think it absolutely certain that they do not belong to the spectrum of the *brilliant portion* of the prominences; but the photograph shows, in addition, an extensive nebulosity surrounding the nuclei, with a pretty definite boundary of its own. This nebulosity is best seen in No. 2 of the totality pictures taken at Burlington. Now, it is *possible* that these lines may belong to this *nebulosity*, and not to the *corona proper*; for I cannot recall, with certainty, whether the 1474 line retained its brilliance at any considerable distance from the prominences. My impression is that it did, and that the text is correct, but do not wish to be too positive. The eclipse of December, 1870, will decide, of course."

suggests the inquiry whether we are to admit the existence of *iron* in the auroral heights of our atmosphere, or are to account for this line in the iron spectrum by some unknown substance of gaseous nature.

The corona showed, also, a faint continuous spectrum without *any trace of dark lines.* The light of this faint spectrum, tested by a tourmaline held in the hand next the eye, was strongly polarised in a plane passing through the sun's centre. As the direction of the spectroscope slit was nearly radial, it is not impossible that Prof. Pickering may be right in explaining this polarisation as caused by the successive refractions through the prisms.

Professor Young's Determination of First Contact.

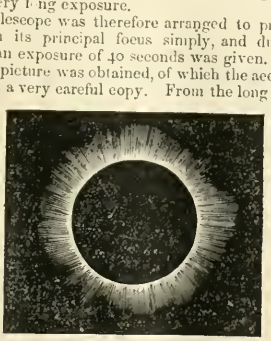
In our notice of this subject we omitted to state that Prof. Young finds that the presence of a prominence at the point of first contact, though facilitating the process, is not essential to his method, since the spectrum of the chromosphere is quite enough for the same purpose.

The Corona and its Photographs.

It is a very fortunate thing that the numerous parties by whom photographs were made of the late eclipse, in hardly any two instances followed the same plan of arrangement or aimed at the same class of results. Thus, the Philadelphia Expedition, in pursuance of Professor Coffin's suggestions, made their preparations with the view of obtaining such "accurate and well-defined pictures as might be the basis of astronomical calculations." In this they have unquestionably succeeded beyond all others, as we hear from all sides, now that pictures have been distributed and compared. Their views of lunar mountains, sun-spots, faculæ, chromosphere, and crepuscule being unapproached, and their views of the solar prominences only rivalled by one obtained by Dr. Curtis.

The party under Prof. Pierce, consisting, photographically, of Mr. Whipple, of Boston, (who, with Mr. Black and the late Prof. Bond, of Cambridge, made, in 1850, the first celestial photograph), addressed themselves exclusively to the recording of that strange phenomenon, the corona. To secure any impression from this object, which, notwithstanding its apparent brightness is remarkably deficient in photographic power, it was necessary to make a very small image, and to give a very long exposure.

The telescope was therefore arranged to produce an image in its principal focus simply, and during the totality an exposure of 40 seconds was given. By this means a picture was obtained, of which the accompanying cut is a very careful copy. From the long exposure



and motion of the moon, as also, probably, of the light in the corona, there is little sharpness of definition, and the prominences only appear as bright spots. The general shape of the corona is, however, very well given, and the curious appearance of curvature, in some parts, is very manifest. This and other pictures—if others than the one we have seen were made—may throw some light upon this extraordinary object.

ON RAISING A HIGHER TEMPERATURE IN CERTAIN SOLUTIONS BY STEAM OF 212° FAHR. (100° C.).

BY PETER SPENCE, F.C.S.

Some twelve to fifteen years ago, the author had occasion to require large masses of liquor to be raised to a temperature of 228° F. (108·8° C.), for the purpose of extracting, by means of long-continued digestion at that heat, of alumina, in the form of sulphate of alumina, from minerals containing that earth. As time was an element of importance in his calculations, the author's aim was to heat the liquors as rapidly as possible; but lead vessels only could be used with the acid liquors; and, as it was requisite to have an iron outside vessel next the fire, the heating was a tedious operation. To overcome this loss of time, the author fitted up a digesting vessel, so as to raise the heat rapidly to 212° F. (100° C.), by injecting steam from a steam boiler into the mass of liquor; and as soon as he had obtained that temperature, he stopped off the steam, and allowed the external fire to operate alone, so as to raise the additional 16° F. (8·8° C.) required, and to maintain the temperature at 228° F. (108·8° C.), his impression being that, above 212° F. (100° C.), the steam, if kept on, would act as a cooling agent, and prevent the temperature rising. The combined operation was perfectly successful, and went on for some time, acting, as the author supposed, in accordance with his pre-conceived theory; but some circumstances led him, subsequently, to doubt whether it was so. He found that if, inadvertently, both steam and fire were left acting after the higher temperature was obtained, the temperature continued, notwithstanding. Again, when the fire was in a condition, through neglect, in which it was obviously of no use, the author was still astonished to find that, as the apparent result of the steam alone, the temperature was at a satisfactory point. This last observation led the author to test the matter in the laboratory in the following manner:—Being convinced that the high boiling point of his liquors had something to do with the phenomenon, he selected a solution of a salt (nitrate of soda) having a high boiling point—about 250° F. (121·1° C.). The nitrate of soda was placed in a vessel surrounded by a jacket; steam was let into the intervening space, until a temperature of nearly 212° F. (100° C.) was obtained; the steam was then shut off, and an open pipe immersed in the solution, and steam from the same source was thrown directly into the liquor; in a few seconds, the thermometer slowly but steadily moved, and minute after minute progressed, until it touched 250° F. (121·1° C.). This thoroughly explained the results obtained in the digesting vessel, and became to the author of immense practical value. He discarded the use of fire applied to his vessels, which had not only been tedious and troublesome in operation, but involved a loss of many hundreds of pounds per annum in destruction of apparatus, and used only steam as a vehicle of heat. As a corroboration of the theory,

which seems to explain the apparent paradox, the author finds that the temperatures of his solutions are in the exact ratios of their specific gravities, and have no connection with the temperature of the steam, which never exceeds 212° F. (100° C.). The greater the specific gravity of his acid solutions, the higher the boiling point; and, therefore, whatever the boiling point of the solution in water of any salt, to that point, or nearly, will steam of 212° F. (100° C.) raise it.

REPORTS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, November 4th, 1869.

Sir Benjamin C. Brodie, Bart., F.R.S., *in the Chair.*

The minutes of the previous meeting having been read and confirmed, the following certificates were read:—

For the first time—Sir Roderick Impey Murchison, Bart., Belgrave Square; John Wiggin, Pharmaceutical and Analytical Chemist, Ipswich; George Harrison, Analytical Chemist, 26, Havelock Square, Sheffield; Thomas Walton, M.R.C.S., and L.S.A., Lecturer on Chemistry at the Hull and East Riding School of Medicine, Kingston-upon-Hull; Edward Smith, Practical and Pharmaceutical Chemist, Strand, Torquay; G. Manley Hopwood, 22, Grosvenor Square, All Saints, Manchester; Thomas Gibb, A.R.S.M., Engineer; Matthew H. Cochrane, 108, Paul Terrace, Glasgow.

For the second time—E. S. Blackwell, Analytical and Consulting Chemist, 6, St. Sacrament Street, Montreal, Canada.

For the third time—Alfred Dudley Keightley, Gatcheck Gunpowder Mills, Old Hall, Milnthorpe, Westmoreland; W. Fletcher Barrett, Lecturer on Physical Science at the London International College; John Morrison, Analytical Chemist, County Wicklow, Ireland; Temple A. Orme, Teacher of Chemistry and Experimental Physics in University College School; W. G. Lewis, Fellow of Oriel College, Oxford.

The last-named gentlemen were ballotted for and duly elected. Mr. Gerstl was elected an Associate of the Society.

The Chairman said the first business before the Society was to consider a paper "*On the Atomic Theory*," which had already been read before the Society by Professor Williamson. This theory was not to be regarded as a fixed and definite system of ideas, but one that had undergone great variation and change. There was the atomic theory of Dalton; then that of Berzelius, and also, in a certain sense, that of Laurent and Gerhardt; and now they had come to a further form of this theory, in which new ideas had arisen in regard to the nature of atoms and their properties; and he (the Chairman) thought it would greatly facilitate the discussion if Dr. Williamson would explain what was the precise form of the atomic theory which he was prepared to maintain and defend, and how they might discriminate that from other forms of the theory which were neither reasonable nor rational. First, there was the question whether there were atoms at all; then, being atoms, what those atoms were, and whether they were endowed with the properties assigned to them in regard to their replacing power, and to what was termed their value.

Professor Williamson, on rising, said that he did not admit that, among chemists, there had been several atomic theories. If there had been, he had yet to learn of them. There had prevailed, he believed, from time immemorial, a belief that matter was built up of small particles; and he might also say that no contrary opinion had ever been embodied in any definite form. Dalton doubtless looked for evidences of what he believed to be true, and saw, in the simple multiple proportions which he specially alluded to, facts which were in accordance with that preconceived conviction; but his was the mere germ of an atomic theory, and the changes which have taken place in it since are consistent with the original notions. The very rapid changes had, in the main, been additions to the starting-point given by Dalton. The line of work so vigorously pursued of late years by many chemists, regarding the order in which atoms are arranged in their compounds, was mentioned by the speaker. His endeavour had been to put together more fully than had been done of late what is known of the chemical evidence; firstly, respecting the limits to the divisibility of matter, and, secondly, with regard to the properties of those finite particles which constitute the limits of divisibility, solely from the point of view habitually employed by chemists in their ordinary working. He had also endeavoured to separate those conclusions which appeared to him warranted by facts from everything else. Whether the smallest particles of matter had a spherical form or not, whether they were in their nature indivisible, whether they were in reality the ultimate atoms of matter, or like the planets of this system, he knew not, nor did such questions exist for him as a chemist. He therefore thought it wise to exclude them, important as they were, from the actually existing atomic theory. The work of Berzelius was perhaps the most significant transition from the original notion of Dalton. Silently these atoms had been accepted by chemists, and the whole course of investigation had been one grand confirmation of the assumption that compounds must have molecular weights corresponding to at least the smallest atomic proportion which would represent the actual numbers of analysis. The perfectly independent observations which had been made in reference to the boiling-points of homologous liquids, the phenomena of diffusion, the equality of volumes of masses containing an equal number of these molecules under similar conditions in the gaseous state, all concurred to corroborate the conclusions necessitated by the atomic theory. Thus, independent workmen hewed stones which, when hewn, were found to fit in exactly with the others, forming a perfectly homogeneous whole. Dr. Williamson concluded his remarks by referring to the atomic values, a term which, he thought, represented in a more precise way than some others what is called atomicity; and he also referred to the difference between direct and indirect combination, a fact which he conceived to be essentially atomic in its nature.

Dr. Frankland was not present when Professor Williamson delivered his lecture, and he had only cursorily looked over the printed memoir; but, so far as he could gather, the object of the author had been to establish the atomic theory as an absolute truth. There had been, he thought, so little, if any, opposition to the application of the atomic theory to the phenomena of chemistry, that a discussion could scarcely be raised upon any other feature of the question than that of its absoluteness. He considered it impossible to get at the truth, as to whether matter was composed of small and indivisible particles, or whether it was continuous—the question belonged to what metaphysicians termed "the unknowable;" but he acknowledged the importance of the fullest use of the theory as a kind of ladder to elevate the chemist from one position to another in his science. He was, however, averse to accepting the theory as an absolute truth. Any attempt to realise by its help the action of attractive or repulsive forces upon matter was excessively difficult; indeed to realise such an action through a perfectly void space was to him quite impossible. The same difficulty presented itself to Faraday, who was often obliged to throw on one side, as an obstacle to his progress, this atomic theory. He said that if matter he assumed to be thus composed of solid particles separated by a void space, then, in considering the phenomena of electricity in connection with that view of matter, this space existing between the atoms must be either a conductor or a non-conductor of electricity. If a conductor, such a thing as an insulator was obviously an impossibility; if it was a non-conductor, such a thing as a conductor was equally incon-

ceivable; so that, apart from chemistry, there were considerations which made it very undesirable for this theory to be represented as an absolute truth. The speaker then referred to the combination which, in certain cases, is effected between gases by the application of heat, and said that, according to the atomic hypothesis, they must assume that the gases, when heated, have their particles driven further asunder; but how, then, could they more readily enter into combination when heated, as was the case with oxygen and hydrogen, and in many other similar instances? No such difficulty presented itself if the gases were regarded as continuous matter. He admired the theory as much as Professor Williamson, and he thought no one could blame him for not making a sufficient use of it; but he did not wish to be considered a blind believer in the theory, or as unwilling to renounce it if anything better presented itself to assist him in his work.

Dr. Odling, as a chemist, was not particularly interested in the question whether matter was infinitely divisible or not, but he did not think that Dr. Williamson's argument had established that conclusion. Dalton was always spoken of as the discoverer of the law, or doctrine, or theory of combination in definite and multiple proportions, to account for which his invention or adoption of the atomic theory was founded; and he conceived Dalton's great discovery to be better expressed as the law of combination in *reciprocal* and multiple, instead of in *definite* and multiple, proportions. Dr. Williamson had said of chemists that all their modes of thought, and all the government of their actions, was based upon the atomic theory; but he (Dr. Odling) maintained that it was based upon the observed fact that certain bodies combined in certain proportions. Dr. Williamson also argued that the atomic theory was based upon the existence of molecules, and that molecules had no *locus standi* in the absence of the atomic theory. He (Dr. Odling) disputed that position, for the fact that the hydrogen existing in marsh gas was divisible into four parts, and the hydrogen existing in ammonia only into three parts, was, he conceived, a fact quite independent of the atomic theory. The laws of combination, as far as they go, were compared by Sir Humphry Davy to Kepler's laws of planetary motion, which were simply a general expression of observed facts; and, in the same way, these laws of chemical combination were general expressions of observed facts upon which the atomic hypothesis was super-induced.

Professor Miller thought that Dr. Odling's arguments had not disproved the atomic theory; if they had not the atomic hypothesis, they were entitled to ask what explanation they possessed of the laws of combination? Certain facts were admitted on all hands, as determined by experiment, and when an important and extensive series of facts was ascertained, the endeavour to explain them by some supposition which embraced the facts, and which enabled them to anticipate new ones if possible, was a necessary result of their mental constitution. Unless some hypothesis were accepted, it was absolutely impossible to reason upon the facts; and if they could not adopt this hypothesis as absolutely true, such a view of the constitution of matter explained all the chemical facts that had hitherto been presented. It appeared to him that those who denied the atomic hypothesis were bound to supply something to enable them to interpret phenomena with the same regularity and order as the hypothesis, the accuracy of which they denied and desired to displace. No one would suppose that the absence of an undulatory theory for light would conduce to the explanation of optical science; and he held that what the undulatory theory was to the phenomena of light, the atomic theory was to the phenomena of chemistry.

Professor Foster thought the question before them was not so much the utility of the atomic theory as its truth. M. Naumann had stated, in his "Relations of Heat to Chemistry," that, if we assumed that in any compound body the components really occupied distinct positions of space, they must assume that body to be incapable of infinite divisibility. He thought the ideas generally entertained of the existence of the constituents of bodies in compounds were not absolutely necessary ideas. The fundamental phenomena of chemical changes might sometimes be explained by returning to the notion of the actual mutability of matter. By operating upon one portion of matter, it was actually transmuted into another, a qualitative and quantitative relation existing between the disappearing and the appearing bodies. From such ideas as these, they could not deduce the necessary existence of atoms; but all our present modes of expression and modes of thought were founded upon an atomic hypothesis or basis.

Professor Tyndall sympathised with the ideas of Professor Williamson; his thoughts had, to some extent, been expressed by Dr. Miller, who had made a strong point in referring to the undulatory theory. That theory was something super-induced upon the facts, which might be readily detached from the theory. But it was in the nature of the human mind, it was in the nature of a profound thinker, when pondering upon facts of this nature, to seek for some underlying principle outside the region of facts, from which the facts followed as consequences. Dr. Odling ought to have gone a step further than Kepler; for something that we now call "the theory of gravitation" was certainly superinduced upon his facts, as the atomic theory is upon the facts of multiple proportions. Professor Foster had justly referred to the consideration that a bad theory was very often useful. The emission theory of light was useful in the hands of Newton, Laplace, Malus, and Brewster; but this theory fell, because, in the progress of investigation, facts arose which were inexplicable by it, and which were completely explained by the undulatory theory. The undulatory theory would successfully front all opposition as long as it was competent to explain the facts of optics; and he apprehended that the atomic theory would stand as long as it was competent to explain the facts of chemistry.

Dr. Mills' conviction was that chemistry had no facts to support the notion of a limit, and the undulatory theory had an immense advantage over the atomic theory, for the existence of waves was a fact, while the existence of a limit was not a fact. It seemed to be forgotten by many writers that matter might be infinitely divisible, and yet that definite proportions might exist, for between two infinites there might be a finite ratio, so that the atomic theory was not perfectly necessary to chemistry He believed that motion was the highest generalisation of modern science, and it therefore afforded the only criterion by which all theories, including those of chemistry, must be judged, and the notion of a limit was practically inconsistent with the idea of a motion.

Dr. Williamson, in his reply, remarked that the benefit accruing from looking at the question from another point of view would be incalculable, and if another view was developed to supersede the present one, he would be among the first to rejoice at it, but he had not to do with the future of this matter. He had endeavoured to put together the actual evidence of the present view, and none of its opponents had been able to find a fallacy in that evidence. He thought it most important to keep the theory at each period of its growth in the modest position which it at present occupies, that of generalising the best-ascertained relations of the elements in their chemical changes.

The Chairman liked to have clear and definite ideas, as far as he was able to realise them, on scientific subjects, and he was unable to consider even an atomic theory in the abstract. The atomic theory, as he understood, was—that matter is made up of finite particles, the aggregate of which could be divided and subdivided until at last only one particle would remain, and this view might be derived from the perusal and common assent of every work on chemistry that defined the atomic theory. He thought that such a view as the physical indivisibility of matter must be separated from the facts and basis of chemistry. Dr. Williamson seemed to think the theory and facts were one, but he

(the Chairman) asserted that they were two distinct things. He must also express his dissent from the views expressed by Drs. Frankland and Miller, with reference to the use of a doctrine or theory in which they did not believe. He could not understand using a theory and denying it at the same time. This theory had, he thought, been often the means of deluding chemists into the belief that they understood things about which they knew nothing. He found the works of Kekulé and Naquèt scribbled over with pictures of molecules and atoms, combined together in all imaginable ways, for which he thought there was no adequate reason, and if there was no reason it was a mischievous thing to do. Many students, he believed, thought the pictures in Naquèt's work were chemistry; they did not draw the distinction between the facts and theory of science. His view was that the ultimate constitution of this material universe was one of those things upon which no light had yet been thrown, and he agreed with Dr. Odling when he said that the science of chemistry did not require or prove the atomic theory. They were bound to have some real and adequate means of working at the science of chemistry, and discovering its laws, and they could effect this either through the investigation of the laws of gaseous combination or the study of the capacity of bodies for heat. When they approached the science through the study of gaseous combinations, they discovered that the combining proportions of bodies were capable of being represented by integral numbers, and they also found an analogous fact in studying the capacity of bodies for heat.

The meeting was then adjourned to November 18th.

Thursday, November 18th, 1869.

DR. A. W. WILLIAMSON, F.R.S., &c., *President, in the Chair.*

THE minutes of the previous meeting having been read and confirmed, the following certificates were read:—

For the first time—Samuel Jefferson, Secretary to the Yorkshire Board of Education, Woodville Terrace, Woodhouse Lane, Leeds; Clements Higgins, Demonstrator of Chemistry, King's College, London; James John Bourey, Analytical Chemist, 10, Stepney Causeway, E.

For the second time—Matthew H. Cochrane, 108, Paul Terrace, Glasgow; Edward Smith, Practical and Pharmaceutical Chemist, Strand, Torquay; Thomas Walton, M.R.C.S., and L.S.A., Lecturer on Chemistry at the Hull and East Riding School of Medicine, Kingston-upon-Hull; G. Manley Hopwood, 22, Grosvenor Square, All Saints, Manchester; John Wiggin, Pharmaceutical and Analytical Chemist, Ipswich; Thomas Gibb, A.R.S.M., Engineer; George Harrison, Analytical Chemist, 26, Havelock Square, Sheffield; Sir Roderick Impey Murchison, Bart., F.R.S., Belgrave Square.

For the third time—E. S. Blackwell, Analytical and Consulting Chemist, 6, St. Sacrament Street, Montreal, Canada.

The last-named gentleman was balloted for and duly elected.

At the request of the President, a paper by William Dittmar, F.R.S.E., and George Cranston, "*On the Formation of Carbonic Ether*," was read by the Secretary.

The authors referred to Ettling's researches upon the action of sodium or potassium on oxalate of ethyl, and had endeavoured to discover the *rationale* of that action. They found that, when ready-formed sodium ethylate (ENaO) is brought into contact with oxalate of ethyl, the former compound, like the metal itself, causes the formation of carbonic ether and carbonic oxide. Dry ethylate (ENaO) was prepared by evaporating the liquid alcoholate in a current of dry hydrogen in a retort heated in an oil-bath, when the compound remained as a white porous mass. On treating dry ethylate with about eight times its weight of oxalic ether, it dissolves, and a yellowish syrup is formed, which sometimes gelatinises on standing. If this mixture is gradually heated, at about 80° C. large quantities of gas (chiefly carbonic oxide) are evolved, and the mass darkens till it is almost black. At 140° the reaction ceases. The mass is then distilled at a temperature not exceeding 200°; and the distillate consists of carbonate of ethyl, sometimes mixed with undecomposed oxalate, and always contaminated with ethylic alcohol. The black residue dissolves in water, and contains oxalate and formiate of soda, and also the soda salts of some complex organic acids. Experiments in order to obtain a basis for the speculation on the nature of the reaction led to the following conclusions:—"ENaO" parts of ethylate, acting upon an excess of oxalic ether, decompose 4 "$(EO)_2C_2O_2$" parts of oxalate of ethyl, and produce 3 "$(EO)_2CO$" parts of carbonate of ethyl, 3 "CO" parts of carbonic oxide, and about 0·4 "EHO" parts of alcohol. The behaviour of dry ethylate of potassium on oxalate of ethyl was qualitatively analogous to that of sodium ethylate; the reaction is, however, more energetic, and begins at a lower temperature.

The PRESIDENT said they were indebted to the authors for their interesting communication. It was remarkable that those bodies should effect the same decomposition as had been observed with the metals themselves; and he hoped the authors would follow up the reactions, so as to show the phases of which they consisted.

Professor WANKLYN said that he had read a paper to the Society in 1864, on "The Constitution of the Ethers of the Fatty Acids," and in it he regarded the ethers as compounds, in which the acid-forming radical was the metal, and the ethyl oxide the chlorous radical. He also presented a paper on the reaction treated of by the authors, and predicted that ethylate of sodium would decompose oxalic ether, and produce carbonic oxide and a carbonic ether, and that an unlimited quantity of oxalic ether might be decomposed by a given quantity of ethylate of sodium; but the paper was not published by the Society. It was gratifying to him to find his prediction verified so long afterwards by gentlemen who had made the experiment without any communication with, and quite independently of, himself.

"*On the Dissociation of Liquid Sulphuric Acid*," by W. DITTMAR, F.R.S.E., was then read.

In the opinion of the author, the experiments of Marignac on this subject seemed to show that "H_2SO_4" exists as a definite chemical individual only in the solid state, and that H_2SO_4, even at low temperatures, must be regarded as a molecular mixture. To determine which chemical individuals they were to assume to be present in the mixture, Mr. Dittmar investigated the behaviour of the acid H_2SO_4 when boiled under pressures differing from the atmosphere. The apparatus used for this purpose consisted of a retort, hermetically connected with the receiver, which communicated with an air-pump so constructed as to serve the purpose of rarefying as well as condensing. The results proved the residues obtained to be almost identical in composition with Marignac's acid. As the acid first subjected to distillation was only a little stronger than the product obtained, it was fair to assume that a further concentration of the residue would not have led to any further change in its composition. Sulphuric acid, when boiled down under any pressure between 3 c.m. and 314 c.m., behaves almost like a mixture of the stable hydrate $12SO_3{,}13H_2O$+excess of SO_3, but the existence of a stable *molecule* of this composition could not be deduced from this fact. The observed facts could be accounted for without denying that in liquid sulphuric acid, even at its boiling point, the majority of the molecules have the composition H_2SO_4. It was known that 'H_2SO_4' vapour consists chiefly of isolated molecules of SO_3 and H_2O; and it was in accordance with Clausius's theory to assume that in liquid sulphuric acid, even at low temperatures, a number of the molecules have assumed the state of motion corresponding to a temperature beyond that of dissociation. The higher the temperature, the greater the ratio of the number of the dissociated molecules to that of the unchanged ones. The liberated H_2O's and SO_3's being formed in the midst of a mass of (H_2SO_4)'s will, probably, mostly unite with compara-

tively cold molecules of H_2SO_4, and form compounds $H_2SO_4+H_2O$ and $H_2SO_4+SO_3$ respectively; supposing the latter compound to be less stable than the former, it is easily understood that, in the distillation of sulphuric acid, the higher the temperature, the more SO_3 will predominate in the vapour.

Professor A. H. CHURCH, M.A., then read a communication on "*Namaqualite*." This mineral occurs in Namaqualand, South Africa, in thin layers of silky fibres, which are true crystals. It is of a pale blue colour; its density is 2·40. Isolated crystals appear transparent under the microscope. In the closed tube it gives off much water, when heated becoming black. The mean percentages deduced from the analysis of five specimens are as follows:—

H_2O	32·38
CuO	44·74
Al_2O_3	15·29
CaO	2·01
MgO	3·42
SiO_2	2·25
	100·09

Regarding the silica as an intruding substance, and the lime and magnesia as replacing a small part of the cupric oxide, the author thought the mineral might reasonably be considered as a compound of 4 molecules of cupric hydrate, 1 molecule of aluminium hydrate, and 4 molecules of water. The oxygen ratio between the protoxides, the aluminium oxide, and the water, is 4 : 3 : 11 nearly, and corresponds to such a view. The mineral belongs to the rare class of hydrous oxides, in which a protoxide and sesquioxide are united. The fact that it is crystallised, as well as definite and constant in composition, demands for it specific rank.

"*Chemical Researches on New and Rare Cornish Minerals* (*No. 6.*)—*Hisingerite*," by Prof. CHURCH, M.A. Under this name the author provisionally describes a brown amorphous mineral found in Cornwall. Its chief characteristics are as follows:—Amorphous: reniform; fissured; dark brown; streak, pale; rust, brown (in some specimens, olive-brown); fragile; fracture, irregular conchoidal; hardness, 2·75; density, 1·74. Before blowpipe in closed tube much water, having faint permanent acid reaction. On charcoal, decrepitates and becomes black. Fuses with difficulty in outer flame to a red brown bead. Boiled in acids leaves a siliceous skeleton.

The mean percentages deduced from three analyses run thus:—

Fe_2O_3	52·94
SiO_2	36·14
H_2O	10·49
	99·57

The mineral also contained 0·82 per cent of P_2O_5 and traces of magnesia.

"*On Chloranil and Bromanil*" (No. II.*), by Dr. STENHOUSE, LL.D., F.R.S., &c.

When phenol was acted upon by chloride of iodine in the presence of water, it yielded a brown crystalline mass, from which chlorinal was obtained. Red oil, obtained in the ordinary process for preparing chloranil, dissolved in a dilute boiling solution of caustic soda, a sufficient quantity of potassic chlorate, and hydrochloric acid, yielded small crystalline scales, consisting of chloranil and terchlorquinone. When the red oil was digested with nitric acid, sp. gr. 1·36, red fumes took place. Chloropicrin distilled over; chloranil remaining in the retort.

Chloranilic Acid was prepared as follows:—Five parts of chloranil, moistened with alcohol, were added to a cold solution of 6 parts of potassic hydrate in 150 of water; the mixture occasionally stirred till the yellow scales disappeared and part of the potassium salt had crystallised out in dark red needles. The chloranilic salt is precipitated by adding from 10 to 15 parts of chloride of sodium; it is then washed with a solution of common salt, and purified by one or two solutions in boiling water, precipitations by common salt, and a final crystallisation from distilled water. The chloranilate is then dissolved in 100 parts of boiling water, and 10 parts of hydrochloric acid is added; on cooling, the chloranilic acid is deposited.

The alkaline chloranilates are prepared by neutralising pure chloranilic acid with the corresponding alkaline hydrate or carbonate.

Chloranilic ether, $C_6Cl_2(C_2H_5)_2O_4$.—One part of chloranilate of silver is digested with five of ethylic iodide until the silver salt is converted into iodide, the excess of iodide of ethyl distilled off, and the chloranilic ether extracted by boiling alcohol.

The action of chloride of iodine on chloranilic acid gave large transparent plates, which were found to be oxalic acid, and a heavy oily layer, which the author is at present investigating. The author is also investigating the action of bromine on chloranilic acid; he has already obtained a substance corresponding closely to $C_6Br_6Cl_2HO$.

Bromanil.—To prepare this substance, Dr. Stenhouse places bromine in a flask with one-third of its weight of iodine and five times its weight of cold water. On adding phenol through a long digestion tube, a strong reaction takes place; the phenol adhering to the side of the tube is then washed down with five parts more boiling water, and the whole digested for one or two hours at 100° C. When cold, the semi-solid contents are freed from the mother liquor with a Bunsen's vacuum filter, and digested with bisulphide of carbon to remove terbromophenic acid. Tolerably pure bromanil remains.

When bromanil was digested with hydriodic acid and phosphorus, bromhydranil, $C_6Br_4O_2H_2$, was obtained. The author also procured terbromhydroquinone and terbromquinone from the action of sulphurous acid on bromanil.

Bromanilic acid was prepared in a similar manner to chloranilic acid.

Bromanil phenylamid was prepared by adding an excess of aniline to bromanil dissolved in benzol, and washing the almost black crystalline plates with boiling alcohol.

The author concludes with an account of the action of bromine on bromanilic acid.

The PRESIDENT, in thanking Dr. Stenhouse for his interesting communication, referred to the beautiful specimens of some of the compounds described which have been sent to the Society by Dr. Stenhouse.

"*On the Salts of Acetylinated Ethyl*," by J. ALFRED WANKLYN.

The liquids having the empirical formulæ $C_6H_{16}O_2C_8H_{14}O_2$, and $C_{16}H_{18}O_5$, respectively, and which were discovered by Geuther, and Frankland and Duppa in the course of their researches on acetic ether, and to which a variety of names have been assigned by their discoverers, have been found to be, in reality, the salts of the new organic radical, "acetylinated ethyl." They show two characteristic reactions—With ethylate of sodium they yield salts of common ethyl, the acetyl being exchanged for hydrogen thus:—

Butyrate of acetylinated ethyl

$$\overbrace{\left.\begin{matrix}C_2H_4(C_2H_3O)\\C_4H_7O\end{matrix}\right\}}\,O + \left\{\begin{matrix}C_2H_4Na\\H\end{matrix}\right\}O = \left\{\begin{matrix}C_2H_5\\C_4H_7O\end{matrix}\right\}O + \left\{\begin{matrix}C_2H_4Na\\C_2H_3O\end{matrix}\right\}O$$

With baryta water, they give alcohol, a ketone, and carbonate of baryta—

$$\left.\begin{matrix}C_2H_4(C_2H_3O)\\C_4H_7O\end{matrix}\right\}O + \left\{\begin{matrix}Ba\\H_2\end{matrix}\right\}O_2 = \left\{\begin{matrix}C_2H_4H\\H\end{matrix}\right\}O + \left\{\begin{matrix}C_2H_3O\\C_2H_7\end{matrix}\right\} + \left\{\begin{matrix}Ba\\CO\end{matrix}\right\}O_2$$

* For the author's first paper on this subject, see CHEMICAL NEWS, vol. xvii., p. 129 (*Am. Reprint, May, '68, page 237*).

wherein H_2 replaces acetyl and butyryl, and the latter do not form acetate and butyrate of baryta, but a ketone and carbonate of baryta, being an example of the common method of producing ketones, but at the temperature of the water-bath instead of at a low red-heat.

The Society then adjourned till Thursday, December 2nd.

We have received the following letter from Professor Wanklyn, respecting his researches on the subject of Messrs. Dittmar and Cranston's memoir:—

To the Editor of the Chemical News.

Sir,—The paper suppressed by the Chemical Society in the year 1864, to which reference was made in the course of the discussion of Mr. Dittmar's admirable research "On the Production of Carbonic Ether," was a short note on that subject, and was intended to form an appendix to my paper "On the Constitution of the Ethers." In this note I expressed the belief that the production of carbonic ether was due to the action of ethylate of sodium on oxalic ether, and that the reaction would be found to belong to the class of so-called catalytic actions. These predictions were made avowedly in virtue of the general views of the structure of the ethers which were then entertained by me, and were, in my opinion, useful as tests of the validity of those theories, and also as illustrative of their nature and meaning. The authorities of the Society, however, appear to have entertained a different opinion, and, out of a tender regard for my reputation as a chemist, suppressed the note.

On referring to the report in the Chemical News (vol. x., p. 233, *Eng. Ed.*), I find the following passage at the end of the abstract of my paper on the ethers:—"An explanation of the formation of carbonic ether from oxalic ether was also given." The note itself has, I believe, never been published, but was referred to by me in a paper "On Formic Ether" (see Chemical News, vol. xvii., p. 144 [*not to be found: Am. Ed'r.*]).

At that period, I was unprepared for such an exercise of paternal solicitude on the part of the officers of the Society, and took no steps to avoid suppression. In more recent times, I have always been in readiness to resist dictation of this sort, and, though frequent attempts have been made on the part of the Society to suppress papers either of my own or of my former colleagues, have never submitted to the smallest suppression. The practical result has been that which might have been anticipated, viz., the scattering of my papers through different journals; and, if chemists should hereafter complain that what I have written on a given chemical subject is not all of it to be found in the pages of the *Chemical Society's Journal*, but is diffused through the scientific press, the fault lies with the officials of the Society, and not with me.—I am, &c.,

J. Alfred Wanklyn,
Corresponding Member of the
Royal Bavarian Academy of Sciences.

London, Nov. 20th, 1869.

GLASGOW PHILOSOPHICAL SOCIETY.

(Chemical Section.)

The opening meeting of the session was held on Monday, the 8th instant, when Dr. Wallace, F.R.S.E., F.C.S. Vice-President, in the absence of Professor Anderson, the President of the section, delivered an address.

Dr. Wallace congratulated the members of the section upon the success which had attended their meetings during the two previous sessions, and hoped that during the present winter they would give the office-bearers of the section their cordial support in endeavouring to promote the prosecution of scientific and applied chemistry in Glasgow. The Chemical Section had been a valuable feeder to the Philosophical Society, and had been a means of encouraging the formation of other sections, as well as stimulating the enterprise of chemists in other centres of manufacturing industry. The speaker then referred to the subject of technical education and the necessity for the establishment of chairs of technical chemistry in our universities. With regard to the munificent offer of Mr. James Young, to found a chair of technology in connection with the Andersonian University, much sympathy was felt for the eminent professor of chemistry in that institution, but they all must regret that they had not amongst them so able a man and so diligent a worker as the gentleman who had been chosen to fill the chair. It was announced, however, that Mr. Young intended to form an independent school of chemistry in Glasgow. Dr. Wallace then gave a sketch of the life and labours of the late Mr. Graham, Master of the Mint, and gave an abstract of his most recent researches on hydrogenium.

The remainder of the address was occupied with a review of the latest contributions to theoretical and applied chemistry.

The next meeting of the section will be devoted to the election of office-bearers and other business matters.

GLASGOW PHILOSOPHICAL SOCIETY.

(Chemical Section.)

A meeting was held on Monday evening, the 22nd inst., Dr. Wallace, F.R.S.E., Vice-President, in the chair.

The following four gentlemen were elected Members of Council, in room of four who retired by rotation:—James Anderson, Esq., 98, St. Vincent Street,; Dr. John Clark, Anderson's University Laboratory; James Couper, Esq., St. Rollox Chemical Works; P. M. Moir, Esq.

Dr. Wallace then made some remarks on the results of his examinations of some waters taken from cisterns in the vicinity of water-closets, in various parts of Glasgow. He stated that the results of his observations, which were made conjointly with Dr. Anderson, went to show that there was not a trace of any gas present which could arise from the decomposition of animal matter. A microscopic examination did not show the presence of any insoluble matters other than ordinary dust.

A new and very different source of danger, however, was revealed by the analyses. It was found that water which had got warm by remaining in pipes which were exposed to warmth, either by proximity to the usual hot-water pipes or otherwise, was frequently contaminated with lead to such an extent as to render the use of the water for dietetic purposes positively dangerous.

NOTICES OF BOOKS.

Nature: "A Weekly Illustrated Journal of Science." Macmillan and Co., London.

We are glad to notice the birth of a new popular journal of science. It was never more wanted than now, for it is undeniable that at no previous period has there been such a manifest desire on the part of the general public to understand somewhat of the great scientific discoveries and generalisations which are perpetually springing up around us. Among the objects proposed to be attained by "Nature," is the urging "the claims of science to a more general recognition in education and daily life," and we are fain to believe that there is now amongst us such a movement in this direction, emanating from diverse sources, that the time is not far distant when science will form as much a part of our own educational system as it does of that of other countries.

"Nature" appropriately opens with a series of aphorisms by Goethe; a semi-poetic composition, formed as it were, halfway between prose and poetry, in which an exalted form of prose almost merges into a regular rhythmus. Of Nature Goethe says:—"She tosses her creatures out of nothingness, and tells them not whence they came, nor whither they go. It is their business to run, she knows the

road. . . . . Her crown is love. Through love alone dare we come near her. She separates all existences, and all tend to intermingle. She has isolated all things in order that all may approach one another. . . She is complete but never finished. As she works now, so can she always work. Everyone sees her in his own fashion. She hides under a thousand names and phrases and is always the same."

The principal papers are "On the recent total eclipse of the Sun" by J. Norman Lockyer, and "On the fertilisation of Winter Flowering Plants" by A. W. Bennett. There is a review of Madsen's *Antiquités Préhistorique du Danemarck*, by Sir John Lubbock, and of Newman's "British Moths," by W. S. Dallas, and other shorter notices. A paper (read at the last meeting of the British Association for the Advancement of Science), by the Rev. W. Tuckwell "On Science-teaching in Schools" contains a number of very useful suggestions, and will be read by science masters with interest. Professor Williamson furnishes an interesting life of the late Professor Graham, and we wish we could commend the accompanying portrait to a like extent. Mr. Geikie gives an account of the meeting of German naturalists at Innsbruck. Among other features of the Journal we find several columns of "Notes," containing a chit-chat account of the matters most discussed in scientific circles at the present time. Finally, there is a *resumé* of recent work in all the more prominent branches of science, and of the proceedings of Societies and Academies. We wish "Nature" every success; it is well supervised, its contributors are manifold, and it is issued by an eminent firm of publishers. It will be a healthy sign of the times and of progress, when every educated man reads a scientific journal as regularly as he reads his "Saturday" or "Pall-mall," and to such a result the issue of "Nature" conduces

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Chemistry: General, Medical, and Pharmaceutical, including the Chemistry of the British Pharmacopœia. By John Attfield, Ph.D. London: John Van Voorst. 1869. 8vo; 624 pages.

The object of the author in compiling this work has been to combine a lecture-companion, reading-book, and practical class-guide in one. It is specially adapted to the wants of the medical and pharmaceutical student, and, with this intention, every substance which is employed in general practice as a remedial agent is chemically described. The work opens with advice to learners regarding the method of study; in which is detailed the requirements of various examining Boards, not, as might be supposed, suggestions as to the manner in which the study of chemistry should be begun, continued, and ended—supposing any ending of such a study were ever possible.

After a short introduction, a description is given of the non-metallic elements; and we can but think that a far too brief space has been allotted to these important bodies. There is, moreover, a want of definiteness which we regret to notice: take, for example, chlorine:—

"*Source.*—This element is a gas. Its chief source is common salt, more than half of which is chlorine. *Preparation.*—About ½ of an ounce of salt, and the same amount of black oxide of manganese, are placed in a test-tube, with sufficient water to cover them. On adding a small quantity of sulphuric acid, the evolution of chlorine commences. . . During these manipulations, the operator will have noticed that chlorine is of a light green colour. . The distinctive property of chlorine is its bleaching power. . . . Chlorine readily decomposes noxious gases, and hence is one of the most powerful of *deodorisers*. Used in excess, it arrests and prevents putrefaction; hence is one of the best *disinfectants*. . . . After the gases (H and Cl) have mixed, the mouths of the tubes are quickly in succession brought near a flame, when explosion occurs, and fumes of hydrochloric gas are formed."

Now, we can imagine nothing more detrimental to the student than the singular want of exactness which is exhibited here at the very outset of the work. He will very naturally imagine that chlorine is a gas under all conditions known to us; that it is readily prepared without heat; that it possesses somewhat the colour of green peas, instead of, to our eyes, a dingy yellowish green, in which the yellow predominates over the green; that its chief property is its bleaching power; that it decomposes all noxious—that is, all unwholesome, or unhealthy, or hurtful—gases; and, finally, that hydrochloric acid gas is visible. We would particularly urge Mr. Attfield to attend more to details in the next edition of his work; for a chemical treatise which lacks accuracy is of little worth, specially to the student.

The "metallic radicals" are discussed at length and with some minuteness; the principal salts are described, and synthetical and analytical reactions are given, accompanied by a symbolic representation of the changes which occur. We are glad to notice that the derivation of words is introduced as frequently as possible, and though we cannot always agree with the roots which are given, it is undeniable that even an indication of the derivation of complex words often affords much assistance to the memory of the student. We would recommend to Mr. Attfield's notice, in connection with this subject, the "Essay on Metallick Words," of Sir John Pettus; the "Lexicon Etymologicon," of Gerard Vossius; and the useful little "Etymological Dictionary," of James Donald. The account of the metallic radicals is concluded by a useful "Analytical Chart for Metals," and by certain "Analytical Memoranda."

A detail account of the "Salts of Acidulous Radicles" is next given, then "Salts of Rarer Acidulous Radicles," their analytical detection, a very concise table of the solubility or insolubility of salts in water, and a chapter on "The Analysis of Salts."

About an eighth of the work is given to the following substances: — Alkaloids, Amylaceous and Saccharine Substances, Glucosides, Alcohol and Allied Bodies, Albumenoid and Gelatigenous Substances, Pepsine, Fatty Bodies, Resinoid Substances, Colouring Matters; and the following is an example of the mode of treatment:—

"*Strychnia or Strychnine.*—Formula, $C_{21}H_{22}N_2O_2$; molecular weight, 334. *Source.*—This alkaloid exists in nux vomica (*Strychnos nux vomica*), and in St. Ignatius Bean (*Strychnos Ignatius*), chiefly in combination with lactic acid. *Process.*—According to the official process for its preparation (*strychnos*, B. P.) the nuts, disintegrated by subjection to steam, and, after drying, grinding in a coffee mill, are exhausted with spirit, the latter removed by distillation, the extract dissolved in water, colouring and acid matters precipitated by acetate of lead, the filtered liquor evaporated to a small bulk, the strychnia precipitated by ammonia, the precipitate washed, dried, and exhausted with spirit, the spirit recovered by distillation, and the residual liquor set aside to crystallise. Crystalls of strychnia having formed, the mother liquor, which contains the brucia of the seeds, is poured away, and the crystals of strychnia washed with spirit (to remove any brucia) and re-crystallised." "Properties." "Reactions." "The Physiological Test," which we certainly think might be conducted in a more humane manner, although the frog is, as usual, the victim. And *apropos* of this, we all remember how the frogs once demanded of Jupiter a king, and what they got for it; now, considering how often frogs are sacrificed on the altar of science, we do think they have a right to demand something from Jupiter in recompense therefor. If there be any believers in metempsychosis in this age, let them think how terrible would be the second death of a relative whose soul had taken up its abode in a frog selected for Mr. Attfield's "Physiological Test." "A small frog" (there is a ray of humanity in the use of the word *small*, for the size might have been left to the discretion of the experimenter) "placed in an ounce of water, to which 1-100th of a grain of a salt (acetate) of strychnia is added, is, in two or three hours, seized with tetanic spasms on the slightest touch, and dies shortly afterwards."

The chapter on "Chemical Toxicology" appears to us to be precise and accurate, but far too short (seven pages) for so important a subject. The "Examination of Morbid Urine and Calculi" occupies eleven pages, and is accompanied by some very good plates of urinary deposits drawn by Mr. H. B. Brady, who is a careful microscopist.

The remainder of the work is devoted to "Quantitative Analysis," and occupies about one-sixth of the entire contents of the book. It is divided into the following sections:—Introductory remarks; Measurement of Temperature; Specific Gravity; Weights and Measures; Correction of the Volume of Gases for Pressure and Temperature; Volumetric Analysis; Gravimetric Analysis; Dialysis. We may specially notice a very detailed table (p. 459) for the quick conversion of thermometric degrees; a long list of specific gravities of "official liquids" and comprehensive tables of from five to seven decimal places of metrical measures and their corresponding English representatives.

Throughout the work we find at the end of each chapter a list of "Questions and Exercises," containing in all 1031 questions. These should be carefully worked out by the student, and will do much to impress facts upon his mind; it is needless to say that the only way in which they can be beneficial is if they are answered direct from memory, not after immediate reference to the book; thus a chapter should be read and if need be re-read, and a week or fortnight afterwards the questions appertaining to it should be answered.

The appendix commences with a long "Table of Official Tests for Impurities in Preparations of the British Pharmacopœia," arranged in the form of "Name of Preparation;" "Impurities;" "Test;" "Page." This will be found of the very greatest value to the pharmaceutical student, and should be so tried and tested that it is fixed in his memory. Then we have "Saturation Tables," and tables of the percentage of various acids and alkalies in solutions of various gravity, and finally a list of the apparatus and reagents required for the three months course of practical chemistry at the hospitals. We are glad to congratulate Mr. Attfield upon an unusually good index containing more than 5000 references, and extending over forty-four pages. To still farther facilitate reference, three kinds of type are introduced into the index, a practice which might more often be followed with much advantage.

The work is not remarkable for any speciality of treatment or design; it bears no great stamp of originality upon it, but there is evidence of much hard work, and it is eminently comprehensive. Mr. Attfield has, however, attempted to put too much into a small space; that which is gained in variety of matter is too often lost in clearness of expression and in detail. He has laboured well at the work, and has introduced the most recent matter (such as the accounts of apomorphia and apocodeia) but what the work really wants is a careful, and by no means hurried, examination of each individual part, with a view to greater accuracy with equal conciseness; it is a grand mistake to attempt too much in books of this nature.

Now the motto and key-note of the work, which is to be found over against the preface, is taken from the "De Augmentis Scientiarum" of Francis Bacon, and is to the effect that some men seek for knowledge from curiosity and inquisitiveness, love of lucre, a livelihood, or reputation, and "but few for employing the Divine gift of reason to the use and benefit of mankind." If our author will look at the original passage, he will find the above a rather loose translation of the last phrase, for it is said "PAUCISSIMI, ut donum ratione divinitus datum in usus humani generis impendant;" and if there were any other word expressing even a less number than "paucissimi" we fear it would have to be employed. If he be among those "paucissimi" he is indeed a happy man, and we envy him. And neglecting all the other reasons for which knowledge is coveted and communicated, who can say he is not among those of whom Bacon speaks as "alii existimationis gratia?" We candidly confess we cannot. No; if this work is to have a Baconian motto at all, we venture to imagine that this will be more appropriate:—"Homo Naturæ minister et interpres tantum facit et intelligit, quantum de Naturæ ordine, re vel mente observaverit; nec amplius scit aut potest."

The Sewage Question Settled by the Purification of Water, and the Manufacture, from Town Sewage, of a Dry and Portable Manure. London, 1869.

In this pamphlet we have an account of the works of the Native Guano Company, at Leamington. If the analyses which are given are reliable, the process certainly seems of much value. The organic matter is separated from the sewage by the addition of "a *solution* of animal charcoal, blood, clay, alum, magnesia, and other chemicals;" it is then allowed to settle, and, after drying in the air, it is ready for use as a manure. The supernatant fluid is colourless, and fish have lived for months in it. The deposit is in the form of a heavy black mud, about the consistency of treacle, and scentless. The following analysis shows the composition of the solid portions of the sewage, and of the fluid which remains after the addition of the compound which precipitates the organic matter (the bulk of liquid is not mentioned):—

	Organic Matter.	Mineral Matter.	Total.
Average of 50 samples of sewage	17·2	37·4	54·6
" " " effluent water	1·4	16·9	18·3

The town of Leamington has about 20,000 inhabitants, and yields nearly 600,000 gallons of sewage daily; from this about 5 tons per day of the dried manure is procured, inclusive of 10 cwts. of ingredients added as precipitants. The dry manure, as sold, possesses the following composition:—

Water	14·1
Organic matter	22·4
Phosphate of lime	9·6
Earthy and alkaline salts	11·2
Insoluble silicates	42·7
	100·0
Nitrogen = ammonia	4·2

The cost of manufacturing the manure is £1 10s. per ton, and it sells for £3 10s. per ton; and the total amount expended on the works has been less than £4000. It is very obvious that, until the precise nature of the substances added as precipitants is made known, together with detail and repeated analyses of the sewage, and of its precipitated products, it would be very unwise to do more than call attention to the scheme, the further application of which we shall await with some interest.

Outlines of Chemistry, or Brief Notes of Chemical Facts. By WILLIAM ODLING, M.B., F.R.S., Fullerian Professor of Chemistry at the Royal Institution. London: Longmans, Green, and Co. 1870. 8vo.; 468 pp.

This work consists of detail notes of the lectures which Dr. Odling has been in the habit of giving at St. Bartholomew's Hospital during the last seven years; of such notes, in fact, as are now frequently printed separately and distributed among an audience. It is much to be wished that this plan (which, if we remember rightly, was first introduced at the Royal Institution in 1862) was more often followed, as it must perforce give the listener a clearer idea of the lecture than he could otherwise have, while it prevents his attention from being diverted by the writing of notes. A lecture, after all, is chiefly for purposes of demonstration, and experiments are too often lost by the student who is desirous of making full notes; it is, moreover, always essential that numbers and complex formulæ should appear in other forms than as a momentary utterance or on the blackboard. This book is virtually a collection of lecture-notes; and the main object of the author was "to furnish the students of St. Bartholomew's with an abstract" of his lectures. Of necessity, such a collection of notes must form "*outlines* of

chemistry;" it is as a picture with all the broad details of design introduced, but without the filling-in and finishing. It is not intended to be used by itself, "but as a companion to the teachings of the lecture-room," and as an aid to the appreciation of more complete works, such as Miller's "Elements" and Watts's "Dictionary."

The work is divided into twelve chapters, the first whereof, although introductory, plunges into the middle of things, and treats of the law of volumes, equivalency, heat of combination, and so forth, and of some of the more complex questions of classification. Thus, in the section on "Acids and Salts," we find such paragraphs as the following:—"Mono-, tri-, and penta- equivalency of same perissad element as nitrogen, in different compounds as N_2O, H_3N, and $CH_4\overset{v}{N}$? Di-, tetra-, and hexa- equivalency of same artiad element as sulphur, in Cl_2S'', $Cl_2S'''O$, and $S\overset{vi}{''}O_2$, and Cl_2SO_2, and $\overset{vi}{SO_4}$? Persistency of different equivalent values in double decomposition, as of stannous and stannic salts by lime—

$$Cl_2Sn'' + CaO = Cl_2Ca + Sn''O$$
$$Cl_4Sn'''' + 2CaO = 2Cl_2Ca + Sn'''' O_2$$

Theoretical views concerning change of equivalency, real or apparent. Hypo- and hyper- saturated compounds, saturation by one another of two equivalencies of same atom (?)." Useful sections on the "Formula of Water," and on "The Heat of Combination," are found at the end of this chapter.

The second chapter treats of hydrogen and of the halogen elements, and the third of the oxygen elements. In the latter, the sulphur acids are discussed at some length, and the various actions of sulphuric acid on metals, oxides, and salts are illustrated very concisely by five reactions, in which, by the interchange of hydrogen for metal, we have sulphurous acid liberated when the strong acid acts upon metals; hydrogen when the weak acid acts upon more basylous metals; water or sulphydric acid when the acid acts upon oxides or sulphides; water and oxygen when it acts upon peroxides; and acids when it decomposes salts. This sort of classification of the action of one substance upon others of varied composition is of great use in fixing the separate qualities of a chemical substance in the mind of the student. In each case we have one constant and two variants, but each variant is the type of a class, and thus the changes become grouped within comparatively narrow limits. The system of types and of analogies is carried out to the fullest extent; on every possible occasion, related substances are compared; such we have in the list of the "oxides of hydrochloric acid, sulphuretted hydrogen, and phosphine" (p. 65). These expressions will appear strange to some of us, but Dr. Odling does not bind himself to any one name; thus H_3PO_4 is both an oxide of phosphine and ortho-phosphoric acid; $HClO_4$ is an oxide of hydrochloric acid and perchloric acid. In the above comparison, they are obviously called oxides of hydrochloric acid, sulphuretted hydrogen, and phosphine, because the compounds are similarly oxygenated, the HCl, H_2S, and H_3P being found in each compound of its respective series.

Chapter 5 treats of the carbon elements, and extends over nearly a hundred pages. To this group belong carbon, silicon, tin, and lead, a grouping which is founded on the tetrad character of these elements, as indicated by their combination with hydrogen, ethyl, fluorine, and chlorine. In the account of silicon, the terms *Siliconides* and *Siliconetted hydrogen* are employed. It is certainly surprising how such a word as "siliciuretted hydrogen" came to be introduced into chemistry, but it was undoubtedly made in agreement with such words as carburetted, sulphuretted, phosphuretted, &c. Nearly the whole of this chapter is devoted to carbon and mono-carbon compounds. These are divided into three groups; viz., the methylic typified by H_4C, the formic typified by formic aldehyde, H_2CO'', and the cyanic typified by hydrocyanic acid, HCN'''.

Chapter 6 gives a description of the Sodium Elements—sodium, lithium, silver, potassium, rubidium, cæsium. With these monad metals are considered the triad metals, thallium and gold, "on account of their each forming a series of monad compounds corresponding to those of potassium and silver." The group of magnesium elements consists of calcium, strontium, barium, beryllium, magnesium, zinc, cadmium, and mercury; and these are distinguished by replacing the hydrogen of hydrochloric acid in the proportion of one atom of the metal to two atoms of hydrogen.

The remaining chapters treat of the other groups of metals; to wit, the Tin Elements—aluminium, tin, didymium, thorium, and indium; the Arsenic Elements—titanium, zirconium, cerium, yttrium, erbium, lanthanum, arsenic, antimony, bismuth, vanadium, niobium, and tantalum; the Chromium Elements—chromium, molybdenum, and tungsten; the Iron Elements—manganese, iron, cobalt, nickel, copper, and uranium; and the Platinum Metals—palladium, platinum, rhodium, iridium, ruthenium, and osmium.

One of the most prominent features of this work, as of all Dr. Odling's works, is the constant attempt to classify—to collect together compounds which, however much they may differ in some respects, have at least one cardinal and prominent resemblance; and in such classifications he has wisely exercised his judgment in deciding which kind of resemblance shall determine the grouping of diverse bodies. This must ever be a matter of difference of opinion among chemists, although, for the good of the science, it is much to be wished that an universal mode of classification should obtain throughout the chemical world. The section on *Equivalency* in the first chapter treats specially of the modes of classification; the primary hydrides into mono-, di-, tri-, and tetra-hydrides; and so with chlorides, &c. Then the division of the elements into monads, diads, triads, and tetrads, and into artiads and perissads.

The derivation and explanation of terms, and the arguments in favour of the applicability of some in preference to others, is left to more detail works on chemistry; as, also, is any account of manipulation, and of the preparation of the various simple and compound substances described. This is by no means an elementary work. It is best fitted for the teacher and for advanced pupils; to those who are engaged in the delivery of long courses of lectures it will be invaluable. It is eminently methodical and systematic; if chemistry could ever be what Dr. Whewell calls "a classificatory science," Dr. Odling would be the man to make it so. The very nature of this work makes it *staccato* in character; and, since we have gone to music for a word, we may also say it is entirely free from *appogiature*. There is not a word too much; every sentence is sharp, precise, and to the point; it is a *précis* rather than a finished treatise. It reminds us of a map in which the principal cities and towns are introduced, while the villages are omitted. Compared with a detail "handbook" or "cours de chimie," it is as M. Logerot's "Souvenir du Nouveau Paris" compared with Fielding's map of that city.

Dr. Odling does not employ one form of phraseology; he appears, indeed, rather to prefer to vary the names of a substance as much as possible. He uses such names as cupric nitrate and zinc chloride "indifferently and alternatively" with nitrate of copper and chloride of zinc. The fact is, we are not to say of chemical compounds "by their names shall ye know them;" we must be so familiar with their nature and composition that we shall know them under any reasonable designation whatsoever. It is thus with friends; at first the name is the entity; while, on better acquaintance, the individuality of the entity manifests itself, and we know him and remember him for his character and qualities, the name in its first form of significance having of necessity vanished. It is thus, also, we suspect, that Dr. Odling wishes us to treat chemical compounds. Thus viewed, such terms

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as "oxide of hydrochloric acid," "nitro-marsh-gas," and "hydro-sodium-carbonate," grate less upon the ear than would otherwise be the case: it is familiarity with the compound designated which is to level the barrier of names. If our friend A. B. chooses to change his name to X. Y., he is the same to us, but to a possible future friend, Z., he virtually becomes another being, because Z knew him not before the change. Similarly, if we are familiar with the composition of the body HCN''', we may call it, "indifferently and alternatively," prussic acid, or hydrocyanic acid, or nitro-marsh-gas, or cyanic hydride; but, to the neophyte, the matter will appear in a very different light. "What's in a name?" Ask the gentleman who whilom bore the name of *Cimex Lectularius*, or that other one (whose name we also prefer to Latinise) who recently wrote to the *Times* complaining of the adverse influence of his name upon his daughter's matrimonial prospects; and no wonder, for he was called *Johannes Curtacola*. Modern chemistry does not allow her children to have faucies of this sort. In all seriousness, our science does contain a marvellous medley of names, derived from the most varied sources—Hebrew, Greek, Latin, Arabic, Spanish, Old High German, and Low Latin, combine to mystify and perplex the student.

Let us now justify our remarks as to the general character and the extreme conciseness of this work by giving one or two extracts taken at random.

"Methene, H_4C, obtainable from methyl alcohol, H_4CO, through intervention of methyl chloride, iodide, &c., by action thereupon of nascent hydrogen; from formic acid, H_2CO_2, by its transmission over ignited baryta; and from disulphide of carbon, CS_2, the sulpho-derivative of carbonhydride, by its joint reaction with sulphuretted hydrogen upon ignited metallic copper."

Again, in the account of the hydrocyanic and cyanic ethers, we find concise, comprehensive statements of the following nature:—

"β-cyanide of methyl unknown. β-cyanide of ethyl made by reaction of cyanide of silver and iodide of ethyl in sealed tubes—$H_3C_2 + AgCN = AgI + H_3C_2CN$; also by action of chloroform on ethylamine, in presence of potash—$HCl_3C + H_2(H_5C_2)N = 3HCl + H_5C_2.CN$. Resistance of this cyanide to action of alkalies. Its immediate decomposition, with absorption of water, under the influence of acids, into formic acid and ethylamine—

$$H_5C_2.CN + 2H_2O = H_2CO_2 + H_2(H_5C_2)N."$$

Throughout, Dr. Odling has employed names which indicate the relationship of bodies to each other rather than their absolute composition. "For example," he says, "although I have no doubt whatever that corrosive sublimate is really a dichloride of mercury, there was a time when I was equally certain of its being a monochloride; and taught by this experience, I now prefer to distinguish it by the name 'mercuric chloride,' and calomel by the name 'mercurous chloride;' whereby I merely imply, what never has been a matter of question, that the ratio of chlorine to mercury is greater in the one compound than in the other." As a consequence of this method, it happens that bodies differently constituted have similarly constructed names; thus CuO, Fe_2O_3, and SnO_2, are cupric, ferric, and stannic oxides respectively. Dr. Odling has carefully avoided the use of any method of graphic notation: "It has," he remarks, "I believe, exerted, and still continues to exert, a most prejudicial influence on the study of chemical science, by making the fanciful sticking together of variously-pronged discs of more importance than the investigation of phenomena." Again, he has not expressed reactions molecularly, because, as he candidly remarks, "In the majority of reactions, I do not myself know what the molecular formulæ of the reagents and products concerned are, and do not think it worth while to make a pretence of knowing."

Now, we have been wont to regard Dr. Odling as the extremest radical in the world of chemists—indeed, as a sort of revolutionary red republican; and we rejoice to find him taking an intermediate course, leaving extreme views to the Raspails and Recheforts of our science. There is no denying the fact that the science has progressed so rapidly of late that the prominent attitude of chemical thought is generalisation; facts have accumulated in such an astounding manner as the army of workers has increased that the desire of collecting particulars has, in many cases, been replaced by the desire of generalising upon the knowledge already attained. The temptation is, indeed, strong, but the science is not yet ripe for such a process. Certain chemists, seeing a little light in the distance, are halloeing before they are out of the wood. They may spare their voices yet awhile, and had better seek for the path which shall lead others from the gloom hereafter. We pray them to bear in mind Plato's exquisite parable of the dim cave, full of shadows which come and go; and to remember that there are two ways of investigating and discovering truth, to the first of which many have attached themselves. "*Altera a sensu et particularibus advolat ad axiomata maxime generalia atque ex iis principiis eorumque immota veritate judicat et invenit axiomata media. . . Altera a sensu et particularibus excitat axiomata, ascendendo continuetur et gradatim, ut ultimo loco perveniatur ad maxime generalia; quæ via vera est, sed*" (too often, we fear) "*intentata.*" With a great din of shouting sounding in his ears, Dr. Odling has wisely preferred to reserve his own voice until he is fairly and fully clear of the wood, and we shall gladly trust ourselves to his guidance.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note.—*All degrees of temperature are Centigrade, unless otherwise expressed.*

Comptes Rendus des Séances de l'Académie des Sciences, October 25, 1869.

The following original papers and memoirs bearing upon chemistry and physical science are contained in this number:—

Remarks on the Communications made by MM. Verguette, Lamotte, and Thenard.—M. Pasteur.—The author of this lengthy and criticising review condemns, in terms fortunately not frequently heard in the Mazarin Palace, the processes of the preservation of wine by heating it. The paper is too lengthy to admit of abstraction, and is, moreover, only of interest to wine-growing countries.

Fundamental Equations of the Mechanical Theory of Heat.—M. Reech.—A purely mathematical paper.

Illumination of Transparent Substances by means of Polarised Light.—M. Lallemand.—In order to see the illumination of any fluid, water, for instance, it is poured into a glass tube, which is closed at both ends by means of pieces of plate glass; the tube is then placed in a dark chamber in a horizontal position, and a ray of polarised light is made to shine upon the tube, which, when looked at sideways, will exhibit a vivid glimmering; but, seen in any other direction, the tube remains dark. Hence it follows that the propagation of the light takes place in the direction of the plane of polarisation; and it also follows that the vibrations of the waves of the ether take place in the perpendicular direction. When, instead of water, any other fluid is taken which is endowed with rotatory power—a solution of sugar, for instance—a very beautiful chromatic effect is displayed; the colours of the spectrum will be seen distributed in an elliptical shape. Cylinders of solid glass, submitted to the same experiment, exhibit somewhat similar phenomena, but less conspicuously than fluids.

Calorific Rays Emitted by the Moon.—M. Marié-Davy.—The author retracts his former negative statements on this subject, and now proves that, by another and differently-conducted set of experiments, he found that the moon emits calorific rays in abundance. The secretary read, also, a memoir on this subject, by M. Volpicelli, who, quoting the observations of more ancient and modern *savants*, comes to the conclusion, also, by his own observations, that the moon emits heat.

Bronzing of Copper.—M. Zalewski.—When objects made of copper are immersed in molten sulphur wherein lamp-black is kept suspended, the objects so treated obtain the appearance of bronze, and can be polished without losing that aspect.

Influence which Divers Luminous Rays Exert upon the Decomposition of Carbonic Acid and the Evaporation of Water from the Leaves of Plants.—M. Dehérain.—The author having extended his experiments on this subject, now states that all the luminous rays are not equally active in the decomposition of carbonic acid; that, even when the intensity is the same, the yellow and red rays act more favourably than the blue and violet rays; that the relation between decomposition and evaporation remains unaltered.

Preparation of Oxygen.—M. Delaurier.—The author states that, when manganate of lime is heated, oxygen is abundantly given off, and that by means of this salt it may be made very economically.

Metrical Weights and Measures.—M. Jacobi writes to the effect that the Royal Prussian Academy of Sciences is favourably disposed towards the proposal to establish an international committee for weights and measures.

Testamentary Disposition by M. Lacaze.—The perpetual secretary, M. Dumas, announces that the late M. Lacaze has bequeathed to the Academy a sum of 10,000 francs (£400), the interest of which is to be applied, bi-annually, to the distribution of prizes for chemistry, natural philosophy, and physiology.

The Journal of the Franklin Institute, September, 1869.

This number contains the following original papers and items:—

Gas Blasting.—While an excavation for a gas-holder tank was being made at Oswego, an old well had been pumped out and then filled up, after leaving an aperture beneath. Into this space a limited quantity of gas was introduced from the gas pipe, sufficient to form an explosive compound with the air in the covered well; this mixture being exploded by suitable means, caused a general upheaving of the surrounding earth, loosening the soil, and making digging easier.

Analysis of Hathorn Spring Water.—Dr. Chandler.—Grains to the gallon—Chloride of sodium, 509·968; chloride of potassium, 9·597; bromide of sodium, 1·534; iodide of sodium, 0·198; fluoride of calcium, a trace; bicarbonate of lithia, 11·447; bicarbonate of soda, 4·288; bicarbonate of magnesia, 176·463; bicarbonate of lime, 170·646; bicarbonate of strontia, a trace; bicarbonate of lime, 1·737; bicarbonate of iron, 1·128; phosphate of soda, 0·006; biborate of soda, a trace; alumina, 0·131; silica, 1·200; organic matter, a trace; total solid constituents, 888·403 grains; carbonic acid gas in one gallon, 375·747 cubic inches; specific gravity, 1·009.

Various Processes for Preserving Timber.—Dr. Ott.—From this paper, which is to be continued, we learn that the first attempts in this direction were made by the German chemist Glauber, and consisted in first charring the surface of the timber, then coating it with Stockholm tar, and immersing it in crude acetic or more properly pyroligneous acid. The author then reviews at length the various methods applied for the preservation of timber, treating of injection with brine, or salting timber, which is not of much use unless, indeed, the salt could be made to penetrate through the very heart. Speaking of Mr. Beer's process, that is to say, the treatment of wood in a boiling solution of borax in water, the author observes that beside the ready solubility of borax in water (one part in twelve of cold water), borax, like all alkaline salts, has the property of dissolving, or at least attacking, the so-called incrustating matter of the wood, upon which its strength, solidity, and toughness greatly depend; moreover, borax also dissolves the resin which is therefore eliminated from the wood, and in regard to its (borax) claimed superiority in withdrawing the putrefiable substances, it may be stated that not less than 14 per cent of the original amount of albumen have been retained in saw-dust, after boiling it several times, and each time for hours with a saturated solution of borax.

Cosmos, October 23, 1869.

Extracts from Vegetables.—M. Berjot.—This gentleman has applied to the vegetables in ordinary use for culinary and domestic purposes the process long since very successfully carried out for vegetables to be used in pharmacy, viz., of expressing by strong hydraulic pressure the juices of such vegetables, and concentrating the same by evaporation *in vacuo*, and preparing extracts thereof suitable for making soups and sauces, 1 gramme of these extracts being sufficient to convert 1 litre of bouillon into a good soup.

Porte-plume-encrier Velocigraphe.—Dr. Poznanski.—Under this title is described at great length, accompanied by a woodcut, an instrument which, if what is stated about it is correct, will, in a very short time, be greatly in demand by all who have much writing to do. The instrument is a combination of pen-holder, pen, and ink reservoir, and the ink flows into the pen by means of a self-acting valve and piston, as long as the writer requires it; we cannot give more details without re-producing the cut.

Estimation of Urea.—Dr Byasson.—Take 50 c.c of the urine to be tested from the urine in a flask, and next add 25 c.c. of baryta water, and shake the mixture, filter off the precipitate, the filtrate from which should be alkaline; take 10 or 20 c.c. of this filtrate, and pour it in a vessel suitable for precipitation, and place the vessel on a sheet of white paper; then add from a graduated burette a mercurial solution (made by dissolving 36 grammes of red oxide of mercury in 5 grammes of nitric acid diluted with as much water; this dissolution is aided by heat and carried on until, by evaporation, red fumes are beginning to be given off, when the saline mass is dissolved in 1 litre of distilled water), keeping the fluid well stirred. From time to time small quantities of a solution of caustic potassa of 25 grammes to the litre are added; by this proceeding a yellow precipitate is formed. This first assay is only approximative, and should be followed by at least two other similar operations. Every c.c. of the mercurial liquid applied represents 0·005 gramme of urea; the mercurial solution is controlled by means of a urea solution made by dissolving 20 grammes of crystallised urea in 1 litre of distilled water.

Zeitschrift für Chemie von Beilstein, No. 19, 1869.

This number contains the following original papers:—

New Method for the Synthetical Preparation of Salicylic Acid and its Homologues.—M. Vogt.—The author says—Some few months ago, M. Oppenheim and I proved that chloride of phenyl is not readily acted upon by fusing caustic potassa, unless that chloride is converted into the corresponding sulpho-acid. While the writer was engaged in experiments with chlorinated toluol and xylol, expecting to obtain orcine and β orcine, the result was the formation of salicylic and cresotinic acid. Chlorinated toluol was mixed with fuming sulphuric acid, and afterwards sub-

mitted to heat; as soon as the chlorinated compound was dissolved, the mixture was diluted with water, and baryta solution was added, until a precipitate ceased to appear. The liquid was next filtered, and neutralized with a solution of carbonate of potassa; in this manner a salt, $C_2H_6Cl\sim O_2K$, was obtained in pearly plates. This compound was fused with caustic potassa, and, after a lengthy purifying treatment, first with water, next hydrochloric acid in excess, then ether, and again saturation with carbonate of potassa, and decomposition, again, of the saline mass by excess of an acid, salicylic acid was obtained, in small quantity, but sufficient to test its most prominent features. Bromated toluol, treated in the same manner, yields the same result. Chlorinated xylol, submitted to the same treatment, yields eresotinic acid, a solid substance which crystallises in elongated prisms, fuses at 148°, difficultly soluble in water, and yields, with chloride of iron, a violet tinge.

Action of Deutoxide of Nitrogen upon Terpen.—M. Bunge.—The author says—Some thirty years ago, M. Cahours published a paper wherein it was stated that deutoxide of nitrogen combines with the terpen of essential oil of feuchel, yielding a substance, $C_{15}H_{24}(NO)_4$, which, consequently, is a nitroso hydrocarbon. These researches of the last-named author have been repeated by the author of this paper, with the following results:—(1) Pure deutoxide of nitrogen does not combine with the terpen of essential oil of feuchel, and is hardly even absorbed by it; (2) when the deutoxide of nitrogen is brought into contact with the aforesaid terpen, air being at the same time admitted, the compound described by Cahours is formed; (3) pure hyponitric acid, prepared from nitrate of lead free from chlorine, is plentifully absorbed by the terpen alluded to, but the result is not the formation of a crystalline substance; (4) when the terpen is mixed with an aqueous solution of nitrite of potassa, to which some acetic acid is added, the terpen is thereby converted into a crystalline mass, which, although identical with that described by M. Cahours, differs from it in composition, its formula being $C_{10}H_{15}(N_2O_3)$. Ordinary oil of turpentine (purified, of course), and the terpen from Copaiva balsam, do not yield, when treated as described, crystalline compounds. When the nitrate of lead, employed for the evolution of hyponitric acid, contains chlorine, or if, purposely, chloride of lead is added to the nitrate, and the gas thus obtained be passed through the terpen of essential of feuchel, this fluid soon becomes turbid, and the result is the formation of a substance insoluble in water and hardly soluble in either absolute alcohol or ether; this compound is expressed by the formula $C_{10}H_{14}NO_2Cl$. The terpen of Copaiva balsam yields an analogous compound.

Formation of Green Sulphide of Manganese by the Wet Way.—M. Muck.—When the salmon-coloured sulphide of manganese is submitted to heat while yet in moist state, it becomes green. The author distinctly states that the green sulphide alluded to is not identical with that obtained by the dry way. After quoting several observations of the same phenomenon recorded by other scientific men, the author says—The salmon-coloured sulphide of manganese, when seen under the microscope with a magnifying power of from 200 to 300 diameters, is observed to be a completely amorphous substance; the green sulphide, however, exhibits, under the same conditions, greenish coloured transparent quadratic tables. The preparations of manganese applied for the purposes of experiments, are perfectly pure, and quite free from any other metals precipitable by hydrosulphuret of ammonium. The results of a series of researches on this subject are, that, when an excess of hydrosulphuret of ammonium is applied as precipitant:—1. Very dilute and cold solutions of the chloride and sulphate of manganese yield a salmon-coloured MnS, which, even when kept for several weeks, does not exhibit the least tendency to become green coloured. 2. The same solutions, when precipitated while hot, yield flocculent precipitates, which are bright green-coloured; the solution of the sulphate yields a precipitate akin in colour to the hydrated oxide of chromium. 3. When the same solutions are quite concentrated, the precipitates formed are, at first, salmon-coloured; but, after a short time, and even without the application of heat, the precipitates, while shrinking enormously, and becoming pulverulent, get green-coloured. When a large proportion of a solution of chloride of ammonium was added to the solutions of the salts of manganese just alluded to, previous to adding the precipitant, a nearly blackish green, very dense MnS was thrown down. The following salts of manganese, in solid state, behave towards hydrosulphuret of ammonium in the manner thereby respectively expressed:—The chloride is rapidly converted into a green sulphide, even at the ordinary temperature of the air; the sulphate is more slowly acted upon, but the result is the same; the nitrate, solid as well as solution, is only partly converted into a green sulphide; the phosphate and oxalate yield, rapidly, a green sulphide; the carbonate never yields a green sulphide, but always the salmon-coloured. A concentrated solution of the chloride of manganese yields, on being precipitated by the hydrosulphuret of ammonium only, then, a green sulphide of manganese when the precipitant is in excess and all the metal thrown down; the green sulphide yielded, on careful analysis, by means of drying in a current of dry sulphuretted hydrogen gas, 7·43 per cent of water. When, instead of hydrosulphuret of ammonium, the various soluble sulphides of potassium or sodium are applied as precipitants, the author never obtained a green sulphide of manganese under any conditions.

Conditions under which the Sulpho-Carbanilide and some Analogous Substances are Decomposed.—MM. Merz and Weith.—The subject treated of in this lengthy essay may be summarised in the following manner: The authors proved that nascent hydrogen has the effect of desulphurising sulpho-carbanilide: but, instead of obtaining, as they expected, methylendianiline, other products appeared. This phenomenon they attributed to the presence of acid, and, therefore, they repeated experiments formerly made, and applied perfectly neutral solutions; but this precaution, notwithstanding the sulpho-carbanilide, was decomposed as before. The paper contains, further, a lengthy description of the origin and products of decomposition of a number of complex organic substances, as, for instance, triphenyl-guanidine, sulpho-carbanilamide, tricarbo-hexanilide, and others.

Action of Permanganate of Potassa upon Quinine.—Dr. Kerner.—One part of pure quinine is dissolved in excess of pure nitric or hydrochloric acid; the solution is heated to about 50° or 60°, and there is added to it a concentrated solution of two parts of permanganate of potassa in water at the same temperature, and the liquid well stirred and heated some 15° or 20° higher. The fluid is separated by filtration, from the precipitate of peroxide of manganese, and next evaporated to about one eighth of the original bulk. The liquid, which should exhibit an alkaline reaction, is next acidified, upon which the new substance, dihydroxyl of quinine, is precipitated; this material will require to be purified from colouring matter by means of a very dilute solution of soda. The purified substance, after having been re-crystallised from its aqueous solution, exhibits a crystalline material, difficultly soluble in cold water and alcohol, and more readily so in these fluids when hot. Its composition is represented by $C_{20}H_{26}N_2O_4$; its formation from quinine may be represented by—

$$C_{20}H_{24}N_2O_2 + H_2O + O = C_{20}H_{26}N_2O_4.$$

On Oxytoliden.—MM. Limpricht and Schwanert.—When an ethereal solution of toluylen is treated with bromine, there is formed, besides bromated compounds, a substance, $C_{14}H_{16}O_2$, which the authors call oxytoliden, in pure state exhibiting a solid crystalline substance, fusing at 172°, subliming at a higher temperature, without decomposition, soluble in ether and alcohol, not acted upon by an alcoholic solution of potassa, neither by reducing agents. The authors obtained, by means of the action of chlorides of phosphorus

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upon this oxytoliden, chloroxytoliden, $C_{14}H_2ClO_2$, a solid substance, fusing at 57°, and soluble in alcohol; trichloroxytoliden, $C_{14}H_2Cl_3O_2$, also a solid substance, fusing at 87°, and readily soluble in warm alcohol; pentachlorexytoliden, $C_{14}H_2Cl_5O_2$, a solid matter, fusing at about 190°, and difficultly soluble in hot alcohol. The structure of oxytoliden is represented by—

$$\begin{array}{c} C_6H_4—O—CH \\ | \\ C_6H_4—O—CH \end{array}$$

On Thionessal, Totallylsulphide, Lepiden, and Oxylepiden.—Dr. Dorn.—Thionessal, $C_{28}H_{28}S$, is not readily desulphurised, even by being heated to a feeble red heat along with either iron or copper filings. The heating of thionessal with chloride of phosphorus also fails to effect desulphuration; but there is formed a bichloride of thionessal, $C_{28}H_{18}Cl_2S$, a solid substance, fusing at 219°. Totallylsulphide resists the action of red-hot copper; but, on being treated with chlorate of potassa and hydrochloric acid, it is readily converted into oxylepiden, and therefore the formula of totallylsulphide ought to be $C_{28}H_{28}S$. Oxylepiden, $C_{28}H_{28}O_2$, when acted upon by reducing agents, is converted into lepiden, $C_{28}H_{28}O$, which does not, however, give up any more of its oxygen to any reducing agents; and when it is treated with chloride of phosphorus, yields a series of products of substitution, containing chlorine—viz., bichloroxylepiden, $C_{28}H_{18}Cl_2O_2$; bichlorlepiden, $C_{28}H_{18}Cl_2O$; pentachlorlepiden, $C_{28}H_{13}Cl_5O$; hexachlorlepiden, $C_{28}H_{12}Cl_6O$; and octochlorlepiden, $C_{28}H_{12}Cl_8O$. All of these are solid substances.

The Pyromucic Acid Group.—M. Limpricht.—The combinations of this group can, according to this author, be deduced from a hydrocarbon—

$$\begin{array}{c} HC=CH \\ | \quad\quad | \\ HC=CH \end{array}$$

In order to prove this statement, a series of experiments have been made, which are recorded in this paper. Pyromucic acid in aqueous solution is decomposed by bromine, with evolution of carbonic acid, according to the following formula:—

$$C_5H_4O_3+H_2O+Br_2=C_4H_4O_2+CO_2+2HBr.$$

There are simultaneously formed a brome substitute, an oily substance, and, under conditions which are not precisely defined, a compound, $C_4H_3BrO_2$, a solid, insoluble in water, alcohol, and ether, and fusing at 84°. Among the products of the complete decomposition of an aqueous solution of pyromucic acid, fumaric acid, $C_4H_4O_4$, occurs; and this acid, treated with sodium amalgam at 180°, yields succinic acid.

Arsenic in the Soda of Commerce.—Dr. Fresenius calls attention to a fact accidentally discovered by him, that the carbonate of soda (neutral), as met with in crystallised state, and as manufactured at the alkali works, now often contains a very perceptible quantity of arseniate, or arsenite of soda, undoubtedly due to the use of sulphuric acid for converting the common salt into sulphate of soda, which acid contains arsenic, derived from the pyrites of which few are quite free from arsenic, and some of which contain that substance in considerable quantity. The tests applied for the detection of this arsenic were not the most delicate in use for this purpose; and the quantity found, though small, is sufficient to affect the purity of preparations for medicinal and chemical use.

Les Mondes, October 28, 1869.

From this number we abstract the following original communications and papers:—

Electrical Explorator.—M. Trouvé.—Although this subject does not exactly bear upon chemical science, we may call attention here to what is stated in the original. The explorator alluded to is a small instrument destined to detect, by means of electricity (galvanic current), any metallic or other objects, but especially rifle-balls and pieces of shot and shell, which may have penetrated the body or limbs of men and animals. At an Exhibition, recently held at the Hague, of objects relating to army surgery, and the necessary means of taking care of the wounded in battles, Dr. Winkhuijsen, physician to His Majesty the King of the Netherlands, ingeniously introduced, in limbs made of plaster of Paris, different projectiles of iron and lead, and was thus enabled to exhibit the action of this very useful instrument, by the aid of which, even though no open wounds exist, the presence of such projectiles may be readily detected with certainty, and the extraction proceeded with. Not only metallic, but also stone and wooden objects, which might have penetrated, can be detected.

On Combustion.—M. A. Beilet.—The author's chief conclusion on this subject is, that the distinction between supporters of combustion and combustibles is a pure fiction; there are neither combustibles, nor supporters of combustion, nor, also, any inert substances. In all reactions, each substance brings with it a portion of caloric, and absorbs a certain quantity thereof. Incandescence and heat are, in many cases, principally, if not solely, due to oxygen, but equally so to other bodies under other conditions. Oxygen is not only a supporter of combustion, but it is as much a combustible as the substances which burn in it.

Galvanic Tinning.—M. Maistrasse-Dupré.—The author, it appears, has been commissioned by the French government to apply, by galvanic means, tin upon divers objects which had been made of so-called galvanised iron—that is, iron covered with zinc. To this purpose he applied galvanic elements made of copper and zinc plates, the length of which is 1·20 metres, the width 0·70 metre, placed in a leaden trough and separated and isolated by means of wooden partitions. The copper sheet was immersed in a mixture of equal parts of acetate of lead and common salt, and the zinc element was placed in weak sulphuric acid, sp. gr. 1·060. This battery remains in constant action and working order for eight days, at an outlay of only 2 francs. When the objects which are galvanically tinned are afterwards heated to the melting-point of tin, the goodness and durability of hot-tinned materials is thus obtained. Copper thus tinned (galvanically), and afterwards heated, is superficially converted into bell-metal, while the method of tinning galvanically has the great advantage over the old method, that it can be applied to objects to which the method of tinning in ordinary use is not applicable.

Automatic Steam-Boiler Feeding Apparatus with Constant Level.—M. Macabies.—In a few words we call attention to an excellent piece of useful apparatus, not a toy or complicated mechanism requiring highly-skilled labour for superintendence. It is placed on the boiler, and, as soon as steam is up, begins its work, and acts uninterruptedly, pumping, or rather sucking, either cold or boiling water, even from great depths, and forcing it regularly into the boiler. There are no parts in the apparatus liable to get out of order; and, though its construction and mode of action could not be well understood without woodcuts, its main principle and action is that of the well-known Monte-Jus.

New Source of Quicksilver.—A layer of quicksilver ore has been recently discovered in the district of Sarawak, Borneo, which ore promises to be one of the richest in the world. A trial of a large quantity of this ore has been made, and proved to yield from 70 to 80 per cent of metal; this ore is, therefore, very nearly pure sulphide of mercury, and is of very rare occurrence, since the average of mercury ores yet known do not contain more than from 2 to 20 per cent of metal. Borneo is rich in minerals of all sorts, and the ores found there are of exceedingly good quality.

Researches on Tobacco.—M. Schlœsing.—Most of our readers will be aware that the sale of tobacco is a monopoly of the French Government; but it is not so generally known that, at the very extensive central manu-

factory at Paris, there is established a very well-arranged chemical laboratory, where researches are being continually conducted with tobacco, in its various stages of preparation, as well as in its green, or, rather, raw-dried state. There are very few substances produced, either by the vital functions of plants or animals, which contain so large a variety of different chemical compounds as tobacco does. The inorganic substances it contains are:—Potassa, lime, magnesia, oxides of iron and manganese, ammonia, nitric, sulphuric, hydrochloric, and phosphoric acids, and silica. The organic substances are:—Nicotine, $C_{10}H_7N$; malic, citric, acetic, oxalic, pectinic, and ulmic acids; nicotianine; a green and yellow resin; wax and fat; albumenoid substances; and cellulose. Nicotianine, also known as tobacco camphor, is a fatty substance, exhibiting the pleasant aromatic odour of tobacco-smoke, and having an aromatic bitter taste. Nicotianine is probably identical with coumarine. Nicotine is an organic base; it is, in the pure state, a colourless, oily liquid, of very acrid taste; soluble in water, alcohol, ether, and oil; and a most dangerous poison. According to the author, the quantity of this substance contained in 100 parts, by weight, of dry unmanufactured tobacco-leaves, ripped from the stems, varies considerably, even for tobacco cultivated in France, from 7·96 to 3·24 per cent; for American tobacco, the quantity varies from 6·87 to 2·29 per cent; while the so-called Habana (properly Caba) tobacco contains only 2·0 per cent of this alkaloid. Snuff, which contains on an average 33 per cent of water, contains 1·36 per cent of nicotine. The quantity of ash contained in tobacco in dry state varies from 19 to 27 per cent. 100 parts of the ash contain:—Potassa, 29·96; soda, 2·76; lime, 39·53; magnesia, 9·61; chloride of sodium, 9·65; sulphuric acid, 2·78; silica, 4·51; phosphate of peroxide of iron, 4·20. The more or less easy combustibility of tobacco does not depend upon the quantity of nitre it contains, since experiments made by the author have proved that the Kentucky tobacco, which contains a large quantity of saltpetre, burns badly, while Java, Maryland, and Hungarian tobacco, which contain hardly any saltpetre at all, burn very well. The author found that tobacco which burns badly, or not at all (at least, not so as to be suitable for the use of smokers), burns very well after having been steeped for some time in an aqueous solution of an organic potassa salt (oxalate, malate, citrate, or tartrate answer the purpose), and next dried. A well-burning tobacco becomes badly-burning, or even non-combustible, by being steeped in aqueous solutions of sulphate of lime, chloride of calcium, magnesia, or ammonia. The rationale thereof lies in the fact that the organic salts of potassa just alluded to yield, on combustion, a very bulky, porous, and light coal, which burns off readily on access of air. This paper contains some very important facts relating to the preparation of tobacco and snuff, obtained on a very large scale, working with some hundreds of thousands of tons annually.

Polytechnisches Journal von Dingler, second number for September, 1869.

This number contains the following original papers relating to chemistry:—

Construction of Sulphate Furnaces (Sulfatoefen).—M. Lunge.—This paper is an excellent contribution to the technology of the manufacture of soda by M. Leblanc's process; but the paper is not well suited for abstraction, since there are added to it several engravings absolutely required for the proper understanding of the subject.

Manufacture of Sulphate of Alumina.—M. Pemberton.—Hydrate of alumina is mixed with sulphuric acid and water in the requisite proportions for the formation of neutral sulphate of alumina, $Al_2O_3,3SO_3+18HO$; the best proportions are 150 kilos. of moist hydrated alumina containing 38 per cent of that hydrate, and 200 kilos. of sulphuric acid at 58 Beaumé (sp. gr. 1·678). These quantities yield from 325 to 340 kilos. of neutral sulphate of alumina, which crystallises readily. It should be borne in mind that no larger quantities than those just named should be operated with at one and the same time, because the chemical action which sets in is very violent, and if the heat thereby evolved becomes too great, the operation is spoiled.

Preparation of Indium in Pure State.—MM. Röszler and Wolf.—The authors make use of the Freiberg zinc for the purpose of obtaining indium. The zinc is dissolved in hydrochloric acid, and next boiled with excess of metallic zinc, whereby a spongy metallic precipitate is obtained of the following composition:—Lead, 1·36; tin, 0·02; cadmium, 0·13; copper, 0·004; indium, 0·015; together, 1·529 per cent of the metallic zinc employed. This mass is first treated with sulphuric acid to remove the lead. The whitish-coloured mass is next treated with boiling water; this solution is again treated with zinc, whereby a spongy metallic mass is obtained, which is acted upon by strong nitric acid, the excess of which is evaporated, and the oxides of tin and any remaining sulphate of lead are eliminated. The residue is taken up with water, to which ammonia is added, whereby the oxide of indium is precipitated; and, after drying, this oxide is reduced to the metallic state by means of cyanide of potassium.

Artificial Preparation of Anthracen.—Dr. Greiff.—The author prefers the preparation of anthracen from asphalte or pitch, instead of coal-tar, since the purification of the product is more readily effected when it is obtained from solid substances, by sublimation, in a manner somewhat similar to the manufacture of carbonate of ammonia. Too much and too long heating should be avoided. The quantities of anthracen yielded by tar, as well as by asphalte, vary greatly, and the cause thereof is not at present well ascertained.

Keeping Water in Tanks made of Zinc.—M. Ziurek.—The author calls attention to the fact that water kept in zinc vessels (reservoirs), or, also, collected from roofs covered with that metal, is invariably contaminated with that metal, and that the use of such water, either for domestic or industrial purposes, is highly injurious to health. The author recommends that, where zinc vessels are used for the purpose indicated, they should be painted over with asphalte varnish or any iron pigment.

Journal de Pharmácie et de Chimie, October, 1869.

This number contain the following original papers:—

Chlorides of Acetylen and Synthesis of the Chloride of Julin.—MM. Berthelot and Jungfleisch.—The authors have made perchloride of antimony act upon acetylen, which is very readily absorbed by this chloride with evolution of great heat, in consequence whereof it becomes necessary to moderate the action so as just to keep the mixture in fluid state. On cooling, magnificent large crystalline lamellæ are deposited, which are a compound of acetylen and perchloride of antimony, $C_4H_2SbCl_5$. This compound is very unstable; it is immediately decomposed by water, and on the application of heat it is converted into perchloride of acetylen and protochloride of antimony, $C_4H_2.SbCl_5=C_4H_2Cl_2+SbCl_3$. Protochloride of acetylen, $C_4H_2Cl_2$, is a clear, colourless, very mobile liquid, exhibiting, in a high degree, the smell of chloroform; its taste is somewhat sweet, and its vapour causes headache; it boils at 55°; water, as well as moist air, decomposes it slowly; and if heated, along with water, up to 180°, it is decomposed into hydrochloric acid and some volatile products. Heated to 360° in a sealed tube, it is entirely decomposed into a black carbonaceous mass and hydrochloric acid, without

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giving rise to any secondary products. Perchloride of acetylen, $C_4H_2Cl_4$, is a colourless fluid, exhibiting the smell and taste of chloroform; it boils at 147°; heated to 180°, along with water, it is slowly decomposed; brought into contact with chlorine gas, it is converted into sesquichloride of carbon. By cautiously treating this compound with an alcoholic solution of caustic potassa, hydrochloric acid is withdrawn, and protochloride of acetylen formed. Heated to 300°, for at least twenty-four hours, in a sealed tube, the chloride of julin is formed, which is obtained even better by allowing the heat to act up to 360° for 100 hours consecutively. The chloride of julin is identical with perchloride of benzine.

Boiling and Melting Points.—M. Fleury.—The determination of temperatures requires a correction for that portion of the column of mercury of the thermometer which is not itself immersed in the hot medium. This correction is very liable to error, which may amount to even 10° or 15°. The author proposes the use of a metastatic thermometer.

Researches on the Bleaching of Tissues.—M. Kolb.—This paper contains the first instalment of a lengthy series of researches on this subject, but it is not well suited for abstraction.

Milk at Marseilles, and Milk in General.—M. Commaille.

Reagent for Copper and Iron.—M. Bellamy.—The alcoholic tincture of Campeachy wood, sometimes applied for the detection of bicarbonate of lime in potable waters, is, according to the author, a most valuable test for the detection of very minute quantities of iron or copper present in water. Both metals turn the colour of this tincture, when added to water containing minute quantities of the same, to a peculiar blue colour. According to the researches made on this subject, 1 grm. of iron, present in 20 cubic metres of water (rather more than 20 tons in weight), has the effect of being perfectly detectable by this tincture—that is, 1 part of metal in 20,000,000 parts of water; but after the water has been boiled, no reaction is observed. The metals are chiefly found in natural potable waters as carbonates.

Analysis of the Spring Water from Santa Catalina and Guadalupe (Canary Islands).—M. Méhu.—This spring, although only situated at 85 metres from the seaboard, does not exhibit any sign of being connected with the sea. The water of the spring is very clear, its taste saline, and the yield abundant; it reddens litmus paper; temperature, 26·66°. The dry residue from 1 kilo. of water, evaporated, and the residue dried at 180°, weighs 8·47 grms. The composition of the solid residue, expressed in grm. weight, is:—Chloride of sodium, 6·0921; chloride of potassium, 0·1080; chloride of calcium, 0·2833; bicarbonate of lime, 0·1482; bicarbonate of magnesia, 1·1654; sulphate of magnesia, 0·8766; silica, 0·1084; free carbonic acid, 1·0112. The weight of the anhydrous salts contained in 1 litre of this water amounts to 8·7828 grms. Guadalupe Spring (*Gran Canaria*).—This spring is situated at a height of 210 metres above sea level, at a distance of 4 kilometres from the sea shore, and at 10 kilometres from the Santa Catalina spring. The temperature of the water of this spring is 29°, and it yields 514 litres of water per hour. The composition of the residue, after evaporation of 1 kilo. of the liquid, and drying at 180°, expressed in grm. weight is:—Chloride of sodium, 0·11666; bicarbonate of soda, 0·79673; bicarbonate of potassa, 0·01978; bicarbonate of lime, 0·42251; bicarbonate of magnesia, 0·26473; sulphate of magnesia, 0·10700; silica, 0·11850; free carbonic acid, 1·05790. Weight of anhydrous salts to the kilo. of water, 1·845 grms.

Preparation of Nitrogen.—M. Levy.—When bichromate of ammonia is heated in a retort, that salt is converted into green sesquioxide of chromium, vapour of water, and pure nitrogen.

Revue Hebdomadaire de Chimie, October 28, 1869.

This number contains the following original papers and communications:—

Proper Mode of Sampling and Preserving the Samples of Raw Sugar for Quantitative Analysis.—M. Weinzierl.—The author calls attention to the discrepancies of the results of the analysis of raw sugars taken from the same large parcel, and submitted to investigation by different analytical chemists, in order to prove, by incontrovertible evidence, that, even when the samples are carefully taken (it is generally done by experienced brokers, who, being provided with proper tools, have thereby the means of taking from every box, cask, bag, kranjang, or basket, as the case may be, a fair sample representing the entire quantity contained in such parcel), the mode of keeping and preserving these samples may seriously interfere with the results of the analysis. For this purpose, the author has compared samples of raw sugar, kept in pasteboard boxes for 24, 48, 72, and 96 hours respectively—(1) kept in similar boxes inside lined with tin-foil; (2) kept in pasteboard boxes which were four times varnished with shellac varnish; (3) pasteboard boxes painted over with the paint ordinarily used for painting sheet iron sugar-loaf forms; (4) samples kept in tinned-iron boxes; and lastly, samples kept in glass-stoppered bottles. The result of analysis of samples thus kept for 96 hours was as follows (the original sample, immediately on being taken, gave, in 100 parts—sugar, 91·70; water, 3·54; impurities, 4·76):—Sample-box 1, in 100 parts—Sugar, 92·90; water, 2·28; impurities, 4·86. Sample box 2—Sugar, 91·90; water, 3·30; impurities, 4·80. Sample-box 3—Sugar, 92·40; water, 2·88; impurities, 4·72. Sample-box 4—Sugar, 91·90; water, 3·31; impurities, 4·79. Sample kept in tinned-iron box—Sugar, 91·80; water, 3·50; impurities, 4·70. Sugar kept in glass-stoppered bottle—Sugar, 91·70; water, 3·52; impurities, 4·78.

Reagent to Detect the Presence of Resin of Guaiacum among Resin of Jalappa.—M. Blacher.—When 50 centigrms. of pure and pulverised resin of guaiacum are mixed in a porcelain mortar with 20 centigrms. of black oxide of copper and about twenty drops of alcohol (not methylated spirits), nothing noteworthy is exhibited; but if to this mixture some fifteen drops of liquid ammonia are added, and trituration continued, there will be seen, within a minute, a beautiful apple-green colour. If this experiment is repeated with the same quantities of material, but pure resin of jalappa taken instead of the resin of guaiacum, the original brown colour of the latter remains predominant, and no greenish or bronzy colouration ensues. The quantities mentioned are not absolute, but the author thinks it best not to depart, in either more or less, from the same. There is formed a *guaiacinate ammoniaco-cuprique* (ammoniacal cupro-guaiacinate).

Nutritive Value of Divers Roots used as Cattle Food and for Sugar Manufacture.—M. Corenwinder.—The author has estimated the quantity of nitrogen contained in the following roots, and found that to amount, percentically:—In yellow beet-roots, 1·087; sugar beet-root, 1·044; rutabaga, 1·41; pulp of sugar beet-root, expressed by Champonnois process, 1·36. What rutabaga is, is not explained. Although not an absolute criterion, the quantity of nitrogen contained in vegetables of this kind expresses fairly their average value as food, taking the other constituents into consideration.

Method for Staining Naturally White-Coloured Woods.—M. Mene.—When naturally white-coloured woods are painted over with a concentrated aqueous solution of permanganate of potassa, which is best kept somewhat warm (tepid), it is possible thereby to give such woods the appearance of palissander or walnut wood. Different kinds of wood behave with this solution in different manner; the wood of pear and cherry trees is rapidly stained; white woods, as, for instance, the acacia (*Rubinia pseudo-acacia*), resists a longer time; and resinous woods, like fir, are more difficultly acted on. The rationale is that the permanganate of potassa is decomposed by the woody fibre; brown

peroxide of manganese is precipitated and fixed by the potassa, which is afterwards removed by washing with water. The wood, after having become dry, is varnished, and is, according to the author, not readily distinguished from naturally dark-coloured woods.

Comptes Rendus des Séances de l'Académie des Sciences, November 2, 1869.

This number contains the following original papers and memoirs:—

Industrial Use of Mineral Oils for the Purpose of Heating Steam Boilers, and particularly Locomotive Engines.—MM. St. Claire-Deville and Dieudonné.—This paper gives an interesting account of a series of experiments made by the authors with locomotives upon the French Eastern Line (Paris to Strasbourg), with a speed of 46 kilometres (about 29 miles) per hour, and upon a portion of the line of railway which is by no means level. The consumption of mineral oil was from 3·44 to 5 kilos., per kilometre, over a total distance of 142 kilometres, run over with heavily-laden trains. The authors state that the combustion was very complete.

Heating of Wines.—M. Thenard.—This subject, which has been repeatedly before the meeting, seems to have given rise to some jealousy, as well as captious controversy. The author of this paper, acting upon the principle, "*Qui bene distinguit bene docit*," states that M. Appert first discovered the principle, that M. Pasteur has given a proper scientific explanation thereof, and that, lastly, M. Vergnette has been the first man who has industrially applied this principle on the large scale with good success.

Asia Minor.—M. Tchihatcheff.—This author presents to the Academy the last, that is, the eighth, volume of his great work concerning a hitherto very imperfectly known part of the globe. This volume comprises the physical geography, climatology, botany, and geology of the above-named country. The author's work is highly eulogised, and is a very valuable contribution to science.

The Chalk of Northern Europe.—M. Hébert.—A lengthy paper on an important geological formation which the author distinguishes according to the presence or absence of some animal remains into groups of different ages.

Chemical Researches of Various Combustible Gases Naturally Occurring in Central Italy.—MM. Fouqué and Gorceix.—The authors have investigated twenty-eight different kinds of gas, collected chiefly in the Appenine Mountains between Modena and Imola, including four different kinds collected at the Lagoni, which yield boracic acid. As instances of the composition of these gases, we quote:—Barigazzo—CO_2, 1·58; N, 1·81; C_2H_4, 96·61. Sassuno—CO_2, 1·14; N, 0·39; C_2H_4, 80·60; C_4H_6, 17·87. Gases from the Lagoni:—Larderello—HS, 4·20; CO_2, 90·47; N, 1·90; H, 1·43; C_2H_4, 2·00. Serrazzano—HS, 6·10; CO_2, 87·90; N, 2·93; H, 2·10; C_2H_4, 0·97. This lengthy paper contains a very interesting account of the localities where the gases have been collected, and is a valuable addition to chemical geology.

A Measure which is Not Effected by Change of Temperature.—M. Soliel.—This author proposes (*rem teneatis amici*) to use beryl, the precious stone, as a suitable material for the construction of a standard measure of length, on account of its exhibiting peculiar properties on being submitted to changes of temperature, whereby it is possible that, under certain condition, it will remain invariable. Unfortunately, there are no beryls found of a metre in length, and, therefore, only a centimetre standard could be made.

Constitution and Motion of Glaciers.—MM. Grad and Dupré.—The chief results of the labours of these authors are the following:—The crystals of ice of the glaciers are arranged in a regular manner, and the constituent molecules of that ice are placed as in frozen water. The velocity of motion of a glacier increases from the bottom to the top, while the maximum of motion coincides with the greatest slope.

Heat Reflected from the Moon's Surface.—M. Baille.—According to this author, the moon's surface emits as much heat as a cube filled with boiling water, covered with lamp-black, having a surface of 6·5 square centims., and placed at a distance of 35 metres from the thermo-electric measuring apparatus employed by the author for his experiments.

Synthesis of Guanidine.—M. Bouchardat.—Four volumes of ammonia gas, and one volume of chloroxycarbonic acid, act upon each other with energy, producing chloride of ammonium and urea—

$$C_2O_2Cl_2+4NH_3=C_2H_4N_2O_2+2(NH_4Cl).$$

On repeating this experiment, the author also obtained urea, but, simultaneously, divers carbonic acid amides, and especially, also, guanidine. The author has operated with large quantities, no less than 150 litres, of chloroxycarbonic acid at the same time, and has obtained thereby:—(1) Guanidine, the sulphate of which corresponds, in composition, to the formula $S_2O_{62}(C_2H_5N_3)H_2O_2$. (2) Urea. (3) Melanuric acid, a white-coloured substance, insoluble in water, soluble in weak aqueous solution of caustic potassa, nitric, and hydrochloric acids; formula, $C_6H_3N_3O_3$. (4) Cyanuric acid.

On Chloral.—M. Bouchat.—During the discussion which followed the reading of this paper, it was incidentally mentioned that M. Personne, director of the chemical laboratory of the Ecole de Pharmacie, Paris, had instituted a series of experiments with chloral upon animals, with the result that chloroform was readily detected in various fluids of their bodies, after the administration of chloral.

Anti-Cholera Tissue.—M. Adeline.—This author, or rather manufacturer, having learnt that, from the experiments and experience of Dr. Burq, copper is a certain antidote against Asiatic cholera, presents samples of various woven fabrics, wherein a certain quantity of copper wire is introduced for the purpose of serving as prophylactic.

Phosphorescence of the Sea.—M. Duchemin.—According to this author, that phenomenon is due to electricity, and the infusoria only act as sharp points do in well-known electrical experiments.

Useful Application of Arsenious Acid.—Dr. Lisle.—If the statements of this physician are confirmed, arsenious acid will become a great boon to a large number of people afflicted with that most dire disease—mental derangement. According to this author, arsenious acid, properly administered, even in apparently hopeless cases, restores about 66 per cent of the afflicted to health.

Cosmos, October 30, 1869.

From this number we abstract:—

Extraction of Benzol from Coal-Gas.—M. Meunier.—All coal-gas contains the vapor of benzol in more or less quantity. By means of cooling mixtures, pressure, and the use of some chemical reagents, as, for instance, strong nitric and sulphuric acids, chlorine and bromine, benzol may be withdrawn, more or less completely, from coal-gas. It appears, however, that the following simple and effective plan, suggested by the author, answers the purpose far better, since it is by a simple application of a solvent that the benzol is obtained:—The gas is made to pass slowly through coal oils (liquid hydrocarbons), the boiling point of which is higher than that of benzol; but it has been ascertained that petroleum, paraffin oils, schist oils, and even fixed fatty oils will answer this purpose equally well. After a time, these fluids become saturated with benzol, and the latter is obtained by fractional distillation. It should be borne in

mind, however, that gas thus deprived of benzol and its homologues loses a great deal of its illuminating power, even so much, in some instances, as to be only fit for heating purposes.

Saccharimetrical Congress at Berlin. There has just been held at Berlin, under the presidency of the well-known Dr. Scheibler, a meeting of some twenty-five chemists, whose chief occupation is the investigation and analysis of raw sugars. The aim of these gentlemen, to fix upon a uniform method for all quantitative estimations of sugar, and thus to insure good and conformable results, has been accomplished. Special committees have been appointed to investigate everything relating to the optical saccharimetry. One of these committees undertakes to investigate thoroughly the optical power of different thin plates of quartz in reference to pure sugar; another committee, again, is engaged in the preparation of a standard sample of pure sugar, and superintending the manufacture of perfect and uniform optical saccharometers to serve as standards. A central laboratory is to be established, with branch establishments at various localities in Germany.

Temperature of the Human Body.—The average maximum temperature of adults above twenty-five years is 37·25°; below that age, 37·1°. The temperature of the human body is subject to diurnal variation—from 6 p.m. until midnight, the temperature decreases, and increases again from 3 a.m. until 9 a.m.; this variation is, on an average, 0·49°. A thermometer placed under the tongue indicates about 40.

Guano from the Chincha Islands.—According to what the editor of *Cosmos* states to be reliable information, the quantity of Peruvian guano is so rapidly decreasing that it is no longer difficult to calculate beforehand the period at which there will be no more forthcoming. The deposit of the Guanope isles, which is, however, of inferior quality, will last for some ten years to come. After that period, the Lobo islets may yield some of this manure; but it has been ascertained that the deposit there found is relatively very poor in ammoniacal salts, and contains, moreover, very much sand.

Vulcanised Caoutchouc.—M. Mouton.—In order to give to vulcanised caoutchouc all that softness which is requisite, for instance, for printing-ink rollers, the author reduces ordinary vulcanised caoutchouc to powder, places it in suitably-shaped vessels, and submits it a second time to the temperature required for vulcanisation. By this means it is rendered soft and smooth, has entirely lost its usual harshness, and is fit for various uses—among these the making of durable printing-ink rollers.

November 6, 1869.

This number contains the following original papers:—

Description of an Oven for Burning Pottery and other Ceramic Pastes.—M. Hofmann.—The contrivance here alluded to is an improvement upon those hitherto in use, which cannot be continuously used, but are only worked by interrupted periods. The furnace, or oven, here described is, in exterior appearance, somewhat like a large lime-kiln; but its interior construction consists of compartments, separated by double walls made of fire-bricks. The consumption of fuel of these ovens is stated to be small. With a circumference of 120 metres, each compartment of the contrivance alluded to is capable of containing 10,500 bricks, and about 4½ millions of bricks can be annually fired by this oven, with a saving of from 50 to 60 per cent of fuel as compared with the old methods.

Preservation of Telegraph Poles.—M. Delarge.—The preservation of the large number of wooden poles in use for carrying the conducting wires has become a very important subject. The author reviews the use of the following substances employed for the purpose:—*Sulphate of copper.*—On inspection of a large number of poles treated with this substance, it was found that, notwithstanding nearly twenty years' service, the wood was in a very excellent state of preservation; but it should be added that very much depends upon the kind of timber used for the purpose, and upon the period of the year when it is cut down. *Creosote* is very extensively applied, and, according to a series of comparative experiments, purposely instituted in Belgium, during the years 1861 and 1862, the durability of creosoted timber is considered equal to that treated with sulphate of copper. Creosote, however, is found to be, in many instances, very inconvenient, both on account of the odor it emits, and on account of the injury caused by its corrosive action upon the hands of the workmen. *Chloride of zinc.*—According to the experience of the Netherlands officers of the Waterstaat, to whom is confided the *matériel* of the telegraphic lines of that kingdom, the use of chloride of zinc has given great satisfaction in the sandy soils of Gelderland; whereas in more calcareous soils chloride of zinc did not answer the purpose at all, a result also observed in Germany. According to the author, there is a good deal of practical experience yet to be gained in this department of chemical engineering, since every day more and more proves that the nature and qualities of the soil wherein the poles and other timber, railway sleepers, etc., are placed, has a vast deal more to do with the preservation of the wood than could be, *à priori*, conjectured.

Annales des Mines, Nos. 3 and 4, 1869.

These two numbers have been issued together, and contain the following original memoirs and papers:—

Mineralogical Tabulated Form.—M. Adam.—This is a concise, but very complete and highly useful, review of the minerals, properly classified in forty-two sections, beginning with hydrogenides, and appendix on meteorites. The table indicates the crystalline shape, hardness, specific gravity, fusibility, and solubility of the various minerals, and contains, moreover, tables of equivalents of the elements and oxidised substances, with the symbols and the quantity of oxygen contained in 100 parts. We, moreover, meet here with a new method for the calculation of the relations of the elementary bodies in any analysis; this may be best explained by quoting the following:—Take, for instance, sulphur, antimony, and silver; the equivalents thereof (O=100) are—S, 200·00; Sb, 1525·00; Ag, 1350·00.

$$\text{Equivalent of sulphur, } \frac{1,000,000,000}{200} = 50·0000$$

$$\text{" antimony, } \frac{1,000,000,000}{1·325} = 6·5573$$

$$\text{" silver, } \frac{1,000,000,000}{1·350} = 7·4075$$

A table being thus made for all elementary bodies, the multiplication by the quotients obtained, of the quantities found by weight as result of the analysis, replaces the division of these same quantities by their equivalents, and yields the same relation; for instance—

Analysis of Miargyrite.

					Rapport, or relation.
Sulphur	21·77	×	50·0000	= 108·850	4
Antimony	41·49	×	6·5573	= 27·206	1
Silver	36·74	×	7·4075	= 27·214	1
	100·00				

The division by the equivalents would have given—

$$\text{Sulphur, } \frac{21·77}{200} = 108·850,$$

and so on for the other elements. This memoir is a most

valuable addition to mineralogy, as well as to the chemistry of minerals.

On Smoke-Coloured Quartz.—M. Comminges-Guitand.—This paper, a letter from the French Minister resident at Berne, contains full particulars concerning the discovery and the exploration of quartz of rare beauty, accidentally discovered in the Tiefengletscher of the valley of Urseren, Canton Uri, Switzerland. We have before had an opportunity of quoting this subject.

Use of Sewage Water in Agriculture, according to Experiments and Observations made Abroad and in France.—M. Freycinet.—This extensive memoir, filling some 130 pages, is not suitable for abstraction, but deserves the notice of all parties interested in this subject.

Mineral Resources of Algeria.—M. Ville.—This is a complete treatise on the mineral resources of Algeria, treating of the mineral fuel; iron ores; ores of copper, lead, and zinc; ores of antimony and mercury; the metallurgical works; the salt springs, salines, and deposits of rock-salt; deposits of saltpetre; quarries or layers of gypsum and alabaster; lime-stones; building-stones; brick-clay; clay fit for making pottery; slates; pouzzolanes (natural cements); sand fit for industrial use; mineral and thermal springs, divided into four groups, according to their chemical composition; and, lastly, on the success which has attended the boring for water in Algeria. This paper is an excellent monograph, and it would be highly useful if so complete a review of the mineral wealth of every European country were published.

Bibliothèque Universelle et Revue Suisse.—Archives des Sciences Physiques et Naturelles, No. 142, 1869.

This number contains no original papers relating to chemistry or allied sciences.

Moniteur Scientifique, November 1, 1869.

This number contains the following original communications:—

On So-called Iodine Green.—M. Peters.—The author of this paper states that he has thoroughly investigated this subject, and has overcome the difficulties especially attending the dyeing of wool with the green dye, now rather inaptly called iodine green. The author points out that the following advantages are obtained by his method:—(1) Woollen and mixed tissues can be dyed in a short space of time with very pure shades; (2) the colouring material is not wasted, but entirely exhausted; (3) the expense does not exceed that of the use of the so-called aldehyde green, but the iodine green is purer and faster, while shades of green, either verging upon yellow or blue, can be obtained which are not affected by artificial light. The process of dyeing is described as follows:—Impregnation bath (*bain d'impregnation*)—for bluish green, 25 kilos. of liquid iodine green, for dyeing wool, and 75 kilos. of water; for yellowish green, add 22·5 grms. of crystallised picric acid. When this mixture is brought to the boiling heat, there is placed in it a quantity of previously well washed wool which has been treated with sumac. The wool is left in the bath for about half an hour, and, on being removed, the excess of fluid is got rid of by wringing or, better yet, by the centrifugal machine. The liquid thus obtained still contains a sufficient quantity of colouring matter to be used again. The green-producing bath (*bain producteur du vert*) consists of—Water, 100 kilos.; strong sulphuric acid, 250 grms.; liquid bichloride of tin, 125 grms. This bath is used at a more or less elevated temperature, which depends, in great measure, upon the strength and quality of the tissues or yarn to be immersed therein. Instead of the liquid iodine green above alluded to, and which is not well suited for transport, the author states that, of the iodine-green paste, as met with in the trade, 10 parts have to be mixed with 200 of water; the addition of picric acid may be neglected, and, instead thereof, a small quantity of sulphuric or acetic acid should be added. Fifty parts of the fluid so obtained should be mixed with 150 parts of water; ammonia should be added, and the liquid filtered; after which it is only applicable as an impregnation bath, as above alluded to.

Prophylactic Properties of Phenic Acid.—M. Schiffmann.—The author writes from Valle-Menier, Nicaragua, Central America, stating that, after a very severe epidemic of Asiatic cholera, which caused, during fifteen months, the death of a large number of people, he commenced the use of phenic acid (carbolic acid), causing all the rooms and passages of his house and gardens to be daily watered with water to every pailful of which a tumblerful of the aforesaid acid had been added. The same plan was adopted in the cottages and gardens occupied by about three hundred people, with the result that not only no more was heard of the cholera, but there was also a cessation of intermittent fever (ague), which had almost continually pestered that locality. The author adds that he observed the extermination of all vermin, and that he also used the acid in agriculture, in order to kill noxious insects, especially ants, which abound in that clime, and do great injury to cacao trees (*Theobroma cacao*). Mixed with paint, the author applies phenic acid to wood-work, which is thus preserved from the attacks of white ants and similar vermin.

On Soaps and the Chemical Analysis thereof.—M. Joffroy.—Several methods have been at various times proposed for the quantitative estimation of the various constituents of soap. The following methods are quoted here:—50 grms of the soap are cut up into thin shavings, and dried in a water-bath until no more loss is experienced on subsequent weighing. 12·5 grms. of the soap, cut into thin shavings, are exposed to the action of the air, in order that the free alkali present may thereby become converted into an alkaline carbonate. The sample is next dried, and afterwards dissolved in strong alcohol. In the residue insoluble therein will be found—(*a*) By means of the balance, the total quantity of free alkali (as carbonate) and other salts; (*b*) by means of neutralisation with a test-acid, the quantity of free alkalies; (*c*) by subtracting the quantity of the latter, the quantity of foreign salts will be obtained—that is to say, chlorides, sulphates, &c., of soda, potassa, and other bases. The alcoholic solution is evaporated to the consistency of a syrup, mixed with water, and decomposed by means of hydrochloric acid, whereby the fatty acids are obtained. These, after having been well washed with distilled water, are dried in a water-bath, and weighed. The aqueous solution from which the fatty acids have been separated is evaporated to dryness, ignited, and the residue weighed. This residue is chloride of sodium in the case of hard or soda soap, and, from the quantity obtained, the soda is calculated. In order to estimate the free fat, that is to say, the fat non-combined with an alkali, 10 grms. of the soap are decomposed with hydrochloric acid; the fatty matter is saponified by means of baryta, and the baryta soap obtained is treated with alcohol, whereby the unsaponified fatty matter only is dissolved. The nature of the fatty acids contained in the soap may be ascertained—that is to say, we may find whether stearic, margaric, or oleic acids predominate—by dissolving 5 grms. of the soap in water, adding to the solution enough sulphuric acid to decompose the soap, and the estimating, by means of a very sensitive thermometer, the melting point of the fatty acids; but it should be borne in mind that this operation only gives an approximate result. Another method of testing soap is the following:—Take 1 grm. of the soap, place it in a suitable vessel (a beaker glass), add ether to it, and next acetic acid in a somewhat smaller quantity. The liquid will separate, after a while, into two distinct layers, the upper of which contains in solution the fatty acids, while the lower layer contains the alkalies and salts, and such substances as might happen to be insoluble in the two fluids just named. By means of a pipette, the fluids are

separated from each other. The ethereal solution is poured into a previously weighed beaker glass and the ether evaporated upon a water bath, and next again weighed with the fatty acids it contains. The aqueous acetic acid fluid is evaporated to dryness, and the quantity of alkali determined according to well-known methods.

Revue Hebdomadaire de Chimie, November 4, 1869.

This number contains the following original papers:—

Apparatus for Distillation and Concentrating Liquids in Vacuo.—M. Mène.—When a closed vessel filled with steam is suddenly and efficiently cooled, this vapour is condensed, and there is produced inside that vessel a perfect vacuum, saving always the tension of the water vapour at the temperature to which it is cooled down. It is according to this principle that an apparatus has been constructed, which is illustrated by wood-cuts, which are essentially necessary to the proper elucidation of the mode of action and arrangement, which is, however, so contrived as to admit of continuous action. The apparatus is made of copper, tinned inside, and is applied with great success to the extraction of the aroma of such plants and parts thereof as cannot, without deterioration of the peculiar fragrancy of the same, be submitted to the ordinary distillation process.

Tubular Germinating Machine for Malt Making.—M. Pavrez-Bourgeois.—The author begins by explaining that preliminary process of beer brewing called malting, which is generally known, although some erroneous opinions are in circulation on this subject. Grain does not, in its healthy and fully ripe state, contain any sugar at all. The process of malting is so conducted that, after the grain has been steeped in water for some hours, and has thereby become quite soft, it is placed on what are technically termed beds, and there kept together in a locality which should not be colder than from 14° to 18°. While spread out on these beds, the grain begins to germinate just as if it were sowed in soil, the radicule makes its appearance. It is necessary, however, to supply to the grain under operation air in sufficient quantity; and, on that account, the grain has to be turned over by means of shovels. The apparatus devised by the author, and illustrated by wood-cuts, is constructed with the view of receiving the grain after it has been steeped: it is put in tubes, which are closed by means of perforated lids, and can be moved by means of machinery. According to experience obtained with this apparatus on the large scale, it is highly satisfactory. The author adds one of the most recent analyses of barley, and of malt obtained therefrom. 100 parts, in dry state, contain, for barley—Dextrine, 5·6; starch, 67·0; sugar, 0; cellulose, 9·6; albumenoid substances, 12·1; fatty matter, 2·6; ash, 3·1. For malt—Dextrine, 8·0; starch, 58·1; sugar, 0·5; cellulose, 14·4; albumenoid substances, 13·6; fatty matter, 2·2; ash, 3·2. During the subsequent mashing process, a large proportion of the dextrine is converted into sugar, and the starch into dextrine. The malt here alluded to is the so-called pale, that is, air-dried, malt.

Composition of Different Kinds of Porcelain.—M. Moron.—The materials used for the manufacture of porcelain vary, as will be seen, considerably. At Nymphenburg, Bavaria, the mass is made up of:—Kaolin from Passau, 65 parts; fine white sand, 4 parts; quartz, 21 parts; gypsum, 5 parts; broken-up biscuit, 5 parts. Vienna:—Kaolin from Zedlitz, 34 parts; kaolin from Passau, 25 parts; kaolin from Unghvar, 6 parts; quartz, 14 parts; felspar, 6 parts; metal (broken and ground-up china), 3 parts. Meissen, Saxon-Prussia:—Kaolin from Aue, 18 parts; kaolin from Sosa, 18 parts; kaolin from Seilitz, 36 parts; felspar, 26 parts; metal, 2 parts. The mixture of materials used at Sèvres is only known to those who have the management of that famous manufactory; the kaolin chiefly comes from St. Yrieux.

Pharmaceutische Zeitschrift für Russland, September, 1869.

This number contains the following original papers and communications:—

Monograph on Iauline.—M. Dragendorff.—This lengthy and exhaustive memoir is a compilation embracing everything relating to this subject. The paper is too lengthy to admit of suitable abstraction.

Chloroform and its Behaviour towards Light and Air.—M. Hager.—The author made a series of researches with commercial chloroform obtained from a firm dealing wholesale in this article. The author's paper is divided into the following sections:—Chloroform of commerce contains, besides real formyl-chloride, other chlorinated compounds, which are not readily separated therefrom. This is proved by the fact that, after the separation of alcohol and water, which are invariably present in all commercial chloroform, a fluid is obtained which begins to boil at from 60° to 61°, and at the end of the distillation boils at 65°. By repeated fractional distillation, it is possible to obtain pure chloroform, which can only be properly tested for by means of its boiling point and specific gravity. Pure chloroform is not decomposed by the action of light only.—When chloroform is exposed to the direct action of the sun's rays, it becomes decomposed, exhibits an acid reaction to test-paper, and there are found, among its products of decomposition, hydrochloric acid, chloroxycarbonic acid, formic acid, and free chlorine. Chloroform is decomposed when air has access to it, even in the dark, although only slowly. A quantity of from 0·75 to 1 per cent of alcohol added to chloroform is sufficient to act as a preservative for keeping chloroform for years, even when exposed to daylight. Chloroform, even if it does not exhibit an acid reaction, may be in a state of decomposition. This decomposition can only be detected by the reaction such chloroform exhibits with ammonia, which then yields with it vapours of chloride of ammonium. The cause and products of this decomposition are not ascertained. The boiling point and specific gravity of chloroform are variously determined by different authors:—The *Pharm. Austriaca*.—Boiling point, 63·5°; sp. gr., 1·49 to 1·5. Dr. Stroecker—Boiling point, 61°. M. Limpricht—Boiling point, 62°. M. Biltz—Boiling point, 62·05. Specific gravity—At 10·2° = 1·50885; at 15° = 1·5020; at 17·75° = 1·4971; at 20·0° = 1·4936.

Action of Iodine upon Arseniuretted and Antimoniuretted Hydrogen.—Dr. Husson.—The author finds that both these gases, when made to pass over iodine, readily yield iodides of arsenic and antimony. The author further suggests that this reaction should be made use of in toxicological investigations. For this purpose, when Marsh's apparatus is used, a small quantity of iodine should be placed in that portion of the tube where, commonly, the metallic mirror is made apparent; that part of the tube is gently warmed, so that the iodine coats the tube; and the gas is then made to pass, care being taken to keep the tube somewhat warm. Should the gas contain arsenic, a yellow-coloured mirror will be at once observed; when the gas contains antimony, an orange-coloured iodide of that metal is formed. The iodide of arsenic yields, when volatilised, yellow-coloured vapours, while the vapours of iodide of antimony are of a deep red hue.

Les Mondes, November 4, 1869.

We learn from this journal that M. Wurtz, the well-known scientific chemist, and Dean of the Medical Faculty of Paris, has been nominated Commander of the Order of the Legion of Honour. Among the number of scientific men who have been decorated as chevaliers of the same order, we meet with the names of MM. Schutzenberger, Friedel, and other well-known scientific men.

Navigation on Canals.—M. Bouquié.—Although this short notice does not exactly belong to the sciences usually treated of in our pages, we cannot refrain from quoting the following curiosity:—The distance from Mons (Belgium) to Paris, by canal, is 350 kilometres. The distance from Cardiff to Singapore is 25,000 kilometres; yet the journeys from Mons to Paris are performed by canal so slowly, that the journey from Cardiff to Singapore, if performed at the same

rate of speed, would occupy eleven years. The coal-laden barges sailing between Mons and Paris make only three journeys during a whole year.

Manufacture of Manganate of Lime.—M. Delaurier.—Manganate of lime, CaO,MnO_3 can be directly obtained by heating together any oxide of maganese, previously reduced to powder, and mixed with slacked lime or chalk in equivalent proportions. The two substances should be intimately mixed, and heated to redness, with contact of air and constant stirring of the mixture, in order to promote the absorption of oxygen. This compound is insoluble in water; it is far more readily prepared than the manganates of soda and potassa, because these are fusible, and, hence, less manageable during the process. The manganate of lime yields oxygen on being heated by itself; and, when treated with sufficient sulphuric acid to convert the lime and manganese into sulphates, two equivalents of oxygen are given off. The waste manganese salts obtained in various manufacturing processes may be usefully applied to the preparation of the manganate of lime.

Apparatus for the Demonstration of the Fall of Bodies.—M. l'Abbé Vassart.

Boiling Point of Water at Localities the Height of which Above Sea Level has been Correctly Determined.—M. Zinrek.—The heights are expressed in metres, the average reading of the barometer at each locality in millimetres, the boiling point in °C. The highest inhabited spot on the globe is the township of Antisana, Peru (4101 metres above sea level)—Barometer, 454; boiling point, 86·3°. City of Quito (2908 metres)—Barom., 527; b.p., 90·1°. Sante Fé de Bogota (2661 metres)—Barom., 5·44; b.p., 90·9°. City of Mexico (2270 metres)—Barom., 5·72; b.p., 92·3°. Hospice du St. Gothard, Switzerland, the highest inhabited locality in Europe (2075 metres)—Barom.. 586; b p., 92·9°. Gavarni, France (1444 metres)—Barom., 634; b.p., 95·0°. St. Ildefonse Palace; Spain (1155 metres)—Barom., 657; b.p., 96·0°. Madrid (668 metres)—Barom., 704; b.p., 97·8°. Munich, Bavaria (538 metres)—Barom., 710; b.p., 98·1°. Moscow (300 metres)—Barom., 732; b.p., 99·0°. Rome (46 metres)—Barom., 756; b.p., 99·8°. Berlin (40 metres)—Barom., 756; b.p., 99·8°. As regards London, the enormous size of this province of houses makes it impossible to define, for that great extent, any average. Those portions nearest to the river are no more than about from 3 to 5 metres above sea level (not to be mistaken for what is locally known as Trinity high-water mark), while the more elevated portions are some 30 to 40 metres above the same level.

Comptes Rendus des Séances de l'Académie des Sciences, November 8, 1869.

This number opens with a—

Reply to the Last Note of M. Thenard on the Subject of the Heating of Wines.—M. Pasteur.—The purport of this paper is to refute some erroneous statements made on this subject, about which a great deal more fuss is made than is consistent with its importance.

The Changes which Flowers of Sulphur and Finely-Triturated Sulphur Undergo when Brought in Contact with Certain Soils.—M. H. Marès.—The author of this paper, a wealthy landed proprietor, and a scientific man of some standing, states the following facts:—Since the year 1854, the sulphuring of vines has become a regular practice in a portion of the south of France; on an average, there has been employed about 100 kilos. of sulphur to the hectare (2·471 acres), making, in sixteen years, 1600 kilos., although the quantity has been far larger in some districts. The question as to what becomes of all this sulphur has attracted the attention of the author, who has instituted a series of experiments and observations at Launac, near Montpelier. The main result of these researches is, that the sulphur is transformed into sulphuric acid, even during the dry summer season, in the short space of time elapsing between the beginning of July and the latter end of August. Sulphate of lime is formed, in case the soil is calcareous, as in the instance alluded to. The conversion of sulphur is more rapid in case the soil has been manured, but not a trace of sulphuretted hydrogen is then given off; or, if given off at all, it is immediately decomposed by the porous substance of the soil, and oxidised to sulphuric acid. The author found sulphate of lime even to a depth of 50 centimetres below the surface of the soil, which does not contain any of that salt but the merest trace, it being a well-known fact that Montpelier, and indeed, the greater part of the littoral of the Mediteranean, in Southern France, is made up of a tertiary limestone formation. This mode of the disappearance of the sulphur explains the necessity of constantly repeating the sulphuring operation of the vines. The author observes that it appears that the presence of sulphate of lime is a prophylactic against the attacks of the vines by the *Phylloxera vastatrix*, since the vineyards in the Département de l'Hérault, which have been regularly sulphured, are free from the attacks of an insect which ravages at present the vineyards in the neighbouring departments of the Vaucluse and Bouches du Rhône.

Transformation of the Hydrate of Chloral into Chloroform within the Animal Body.—M. Personne.—According to M Liebreich, the hydrate of chloral should be transformed into chloroform, when coming into contact with the alkali of the blood, according to the following formula:—

$$C_4HCl_3O_2,H_2O_2 = C_2HCl_3 + C_2H_2O_4;$$

that is to say, that the hydrate of chloral should become split up into chloroform and formic acid. This statement of the Berlin gentleman above named has been found incorrect by several French chemico-physiologists; and, in order to set the question at rest, the author of this memoir has instituted a series of experiments, partly with fresh blood, and partly with live animals, and has also made other crucial experiments, with the result that the hydrate of chloral is really split up—when in contact with blood in a living animal—first, into chloroform and formic acid, which, however, are ultimately converted into chloride of sodium and formiate of soda.

Chloride of Gold.—M. Debray.—The author says, It is a well-known fact that, when chloride of gold is submitted to a temperature of about 200°, it is first decomposed into protochloride of that metal and chlorine, and, if the temperature still rises, into chlorine and metallic gold. It is, however, possible to obtain crystals of chloride of gold by sublimation, by the following process:—A current of chlorine gas is made to act upon gold beaten out to a thin foil (not gold-leaf), placed in a glass or porcelain tube, and heated to 300°, at which temperature the volatilisation takes place and ruddy-coloured crystals of the chloride are obtained. The author observes that Boyle was the first who stated that chloride of gold is volatile, to some extent, without dissociation.

Bronze fit for Sonorous Instruments.—M. Riche.—It appears that, at the request of M. Dumas, in his capacity as President of the Committee for the French Mints, the author has made a series of experiments at the Hôtel de la Monnaie, Paris, on divers alloys of bronze brought from China and Japan, containing tin and copper in the proportion of 20 and 80. There have been cast, at the works just named, bars of bronze containing, respectively, 21·5, 20·0, and 18·5 per cent of tin; these bars have been submitted to hammering at temperatures varying between bright red heat and the ordinary temperature of the air. When cold, this metal is as brittle and as breakable as glass; at from 300° to 350°, a perceptible improvement takes place; and at dull red heat the metal works as easily as iron or aluminium bronze; even under the steam hammer, the metal is flattened without breaking, and may be beaten out to sheets of a millimetre thick, but requires, if hammered, a constant annealing; while under the rolling-mill it is even better and more rapidly wrought. When hot, the metal can be cut as if it were iron or steel; with the latter metal it agrees in having a very fine grain and being very homogeneous.

[English Edition, Vol. XX., No. 520, page 240; No. 521, page 249.]

It can be soldered without difficulty with jewellers' solder The density of these alloys was found to be as follows:—Bronze with 21·5 per cent of tin, after having been cast, sp. gr., 8·938—after hammering, 8·929; bronze with 18·5 per cent of tin, cast sp.gr., 8·882—after hammering, 8·938; bronze with 20·0 per cent of tin, cast sp.gr., average of three estimations, 8·914—after hammering, 8·920. These alloys are very sonorous, and similar to that of the Chinese gongs.

Yellow Coralline.—M. Laudrin.—The author states that, according to his experiments, the yellow coralline is as little poisonous as the red dye of that name, also known as peonine.

Sugar Contained in Melons.—M. Petit.—The author has carefully studied the formation, as well as the disappearance, of sugar (crystallisable cane) in various fruits. As regards the melon, the rind never contains any other sugar than glucose; the pulp contains glucose in unripe state; and while the process of ripening is proceeding, cane sugar is formed, and increases in quantity, so as to be very soon in excess of the glucose. The formation of cane sugar begins in the most sour part of the fruit—that is to say, in the pulp surrounding the seeds; the formation of cane sugar is not, therefore, due to the previous existence of glucose, nor does the former result from the latter.

Polytechnisches Journal von Dingler, first number for October, 1869.

This number contains the following original papers and communications relating to chemistry or allied sciences:—

Smoke-Consuming Furnace.—M. Mignet.—The consumption of smoke remains a great desideratum for industrial as well as domestic fire-places; from what is stated in this paper, to which some engravings are added, it appears that a real improvement has been made in this direction by the author, who is not, however, fully acquainted with what has been done concerning this subject in England.

Machinery for the Manufacture of Gas from the more Volatile Portions of Petroleum.—Dr. Petersen.—After referring to the advantages of gas for illuminating purposes in general, the author reviews and describes, accompanied and illustrated by engravings, some mechanism devised by German makers, for making and burning a mixture of air and vapours of what is now called gasoline; sp. gr., 0·682. The apparatus consist mainly of an air-compressing pump and reservoir for air; and for the gasoline, which, in a current of air, if not too cold, is readily and completely volatilised, and yields, on burning from an argand burner, a light equal to 18 standard candles, while the cost is only a trifle higher than good cannel-coal gas. Gasoline, as prepared on the large scale, is quite free from sulphur and ammonia, and its combustion is complete, resulting in the production of water and carbonic acid only. The apparatus, for five lights, costs 100 thalers (£15); for 200 lights, 750 thalers (£112 10s.).

Waters Contaminated with Fatty Matters considered as Feed-Water for Steam Boilers.—M. Triepke.—The author states that it has frequently been observed that new steam boilers have become quite unfit for service in consequence of getting leaky, and that this defect is due to the fact that the feed-water often becomes contaminated with dirty grease, which is forced into the boilers along with hot water, and is derived from the grease used in packing of the piston-rods and other parts of the machinery. The author states that the addition of 1 lb. of crystallised soda upon 10,000 lbs. of feed-water is sufficient to prevent the effect ascribed to greasy matter taking place; and this confirms the observations made by MM. Borsig and Farcot, the eminent engine-builders of Berlin and Paris.

Quantity of Metallic Lead met with in Litharge.—Dr. Wittstein.—The author refers to the well-known mode of the manufacture of litharge on the large scale, and states that a colleague of his (an apothecary) had called his attention to the fact that it had often happened to him while making *emplastrum diachylon simplex*, to discover metallic lead in the vessel wherein that operation was performed. The author instituted a series of experiments, which gave, as result, that, whereas some kinds of litharge are quite pure oxide, other samples contained from 1·25 to 3·10 per cent of metallic lead in finely-divided state. Pure litharge, free from metallic lead, should dissolve freely in acetic acid. If the litharge contains lead, it remains insoluble.

Bismuth from Peru.—Dr. Barth.—Since bismuth has become a rather expensive metal, more attention has been paid to the search for its ores. The author obtained a large sample of bismuth from Peru, which, on being analysed, was proved to contain in 100 parts:—Bismuth, 93·372; antimony, with a little tin, 4·570; copper, with a trace of iron, 2·058. This bismuth is very valuable, on account of being quite free from arsenic and sulphur, and is very suitable for pharmaceutical use.

Coal Tar Colours.—M. Chateau.—100 lbs. of coal-tar yield—3 lbs. of raw, and 1½ lbs. of pure benzol. This quantity yields—3 lbs. of nitrobenzol, 2·25 lbs. of rosaniline, 3·37 lbs. of aniline red, and 1·12 lbs. of fuchsine; 1 lb. of pure fuchsine requires 3,000 lbs. of pit-coal. The quantity of coal-tar produced by the entire number of gas works of Europe is sufficient to yield, annually, 53,000 cwts. of fuchsine.

Analysis of an Eatable Clay.—M. Hebberling.—The author obtained, from a friend residing at Berbek, Kedirie, Java, a clay which is eaten by the natives and regularly sold in the markets. In 100 parts, this substance contains:—Silica, 39·711; peroxide of iron, 9·866; alumina, 25·939; lime, 3·025; magnesia, 1·352; protoxide of manganese, 0·591; potassa, 0·572; soda, 3·858; water and volatile matter (including 0·566 per cent of ammonia), 14·801—of this material, 72·792 per cent is insoluble in hydrochloric acid.

Les Mondes, November 11, 1869.

This number contains the following original papers and communications:—

Instructions Given by the Conseil de Salubrité Board of Health concerning the Use of Domestic Heating Apparatus.

Rendering Petroleum and Paraffin Oils Uninflammable and Inexplosive.—M. Garnier.—The author somewhat verbosely discusses this subject. The main facts brought forward are that experience has sufficiently taught that the temperature of minimum inflammability at 110° F. (43°) is too low, and that, very properly, that temperature should be altered to 180° F. (82°). The author next states that it is possible to render these oils uninflammable and devoid of smell by a chemical process which is not further explained, but which, while rendering the oils absolutely safe, does not interfere with their proper use and applications.

Oleaginous Plants.—M. Heuzé.—Among the *accusés de réception*, attention is called to a very useful work, treating, in a practical manner, on all vegetables the seeds of which produce oil of any kind, recording the history, cultivation, diseases, and, in one word, everything relating to this subject. The book is highly eulogised as the work of a very competent authority who holds office as Inspector General of Agriculture.

Agronomic Stations and Agricultural Laboratories.—M. Grandeau.

Preservation of Beet-Root.—Count Robrinski d'Arlovetz.—One of the drawbacks of the manufacture of sugar from beet-root has always been, and is yet, the proper mode of preservation of the roots, which, in fact, is a problem not so readily solved, and least of all in countries subject to severe winters, since, if the roots are frozen, they are spoiled. The author is a large lauded proprietor in Russia (where,

by the bye, the manufacture of sugar from beet-root is greatly encouraged, it being the well-known policy of the Government of that empire to become, as much as possible, independent for articles of home consumption from other countries). The following conditions are to be complied with for properly attaining this object:—(1) No root should be at more than one metre's distance from a proper current of air; (2) every cubic metre of beet-roots requires at least a surface of 30 square decimetres, freely exposed to air; (3) that the cellars in which the roots are stored be aired every day, and care taken that the temperature therein does not rise above 4°: (lastly) care has to be taken that the roots do not become flabby by evaporation of too much water (10 to 12 per cent of their weight), in which case it would be necessary to water the roots, which, however, is always a dangerous proceeding, since it may lead to putrefaction.

Preservation of Stone by the Use of the Black Oxide of Copper and its Salts.—Dr. Robert.—This paper treats on a very interesting subject. The author proves that the decay of stone, granite, marble, limestones, sandstones—in a word, all natural building stones—is the effect of a concourse of various causes, and that among these a very minute lichen, the *Lepra antiquitatis*, is one of the worst enemies of the stone; and this to such an extent that, for instance, the beautiful marble sculptures of the well-known Parc de Vorsailles, will, unless proper measures are taken for staying the process of decay, be unsightly and ugly masses of dirt, and quite irretrievably lost as works of art within another fifty years. The author, taking as instances such buildings, at Paris, as the Bourbon Palace, the Palais du Corps Législatif, the Mazarin Palace (l'Institut), the Mint, and others, points out that dust, spider's webs, and the action of rain combine with the minute lichen above alluded to, to call forth the decay of stone, especially of such parts, first, where any sculpture or ornamental carving promotes the deposition of dirt and dust. The author conclusively proves (and brings on instances which every one can see, and which, moreover, are important, in consequence of the length of time which has elapsed since the protective action of the black oxide and salts of copper commenced), that the action of the two last-named substances is, undoubtedly, preservative to stone. In reference to granite, the author states that (and an instance thereof can be seen at Waterloo Bridge) this stone is, also, according to the experience of Egyptian engineers, far more readily affected by a moist climate than one would be led to believe. The obelisk of Luxor, brought from Upper Egypt to Paris, has become blanched and full of small cracks during the forty years it has stood on the Place de la Concorde, while forty centuries had not perceptibly affected it as long as it was in Egypt. Granite, in a moist climc, becomes the seat of a microscopically-small cryptogamic plant, which greatly aids destruction; and it is, moreover, a well-known fact, that the disintegration of this stone, consisting of three separate minerals (quartz, mica, and felspar), depends very greatly upon the thorough and intimate mixture, as well as upon the chemical composition, of the same, each of these minerals, separately, being readily enough weathered.

Cultivation of Sugar-Cane in New Caledonia.—M Joubert.—It appears, from a letter written by the person just named, that New Caledonia will become a sugar (cane) producing country. There are two sugar works in existence already, and two others are being built; the necessary machinery having been shipped from the Ile de la Réunion. Since it is a well-known fact that Cuba and other countries, from which a very large proportion of the supply of sugar is obtained, are rapidly on the decline, as regards quantity, it is a gratifying fact to find that the country above named will soon be enabled to supply a not inconsiderable amount of this commodity.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 15, 1869.

From the *procès verbal* of the first meeting of this Society held after the holidays, we learn that, among other foreigners, the following Englishmen have been elected members:—Professor Crum-Brown, of Edinburgh, and Dr. W. Kellner, of Woolwich. The president, Professor A.W. Hofmann, alluded, in a few words, to the death of the late lamented Mr. T. Graham, who was an honorary member of this Society. As a token of respect to the deceased *savant*, the assembly rose *en masse*, and a deep silence was observed for a few moments. The president next exhibited to the members a medal made of the alloy of palladium and hydrogenium, sent over by the late *savant* just alluded to, a few days before his death, to Professor Magnus, of Berlin; this medal bears on one side the effigy of Her Majesty Queen Victoria, and on the other side the name of Graham and the words "Palladium-Hydrogenium, 1869." There is added to the medal a short paper, which states that the medal contains 900 times its own bulk of hydrogenium, and, since the thickness of the medal is 1 m.m., a layer of hydrogen of a height of nearly 1 metre is condensed in that thickness of metal.

The following papers were read:—

On Chromates.—M. C. Freese.—The researches on this subject extend over a series of the salts alluded to, beginning with silver. The author distinctly points out that there exists only a neutral and a bichromate of the oxide of that metal, but no basic salt. The protoxide of mercury yields a normal neutral salt. By precipitating an excess of HgN_2O_6 with $K_2Cr_2O_7$, the precipitate obtained is not decomposed by washing with water. There exists only one basic chromate of peroxide of mercury. The older works on chemistry speak of basic chromates of copper of a green colour; the author says that green colour is due to basic sulphate of copper, or to hydrated oxide. The only known and well-defined chromate of copper, Cu_3CrO_6+2aq, is brown-coloured. Cupro-chromate of potassa is produced when cold solutions of $CuSO_4$ and K_2CrO_4 act upon each other; the double salt so obtained is split up by boiling water into K_2CrO_7, and sesquichromate of copper—

$$KrCu_3Cr_3O_{12}+2aq=(K_2Cr_2O_7)+(Cu_3CrO_6+2aq).$$

The chromates of zinc, cadmium, nickel, and cobalt are briefly alluded to, as, also, the basic chromate of protoxide of manganese.

On Sulphine Compounds.—M. Dehn.—The author says—Since it has been proved by M. Oefele that, when sulphide of ethyl acts upon iodide of ethyl, there is formed a monatomic radical, wherein the nitrogen is replaced by sulphur, I have tried to obtain similar compounds from diatomic alcohol radicals, using the sulphide of ethyl and bromide of ethylen as starting-point for my experiments. When these substances are heated in sealed tubes, along with water, to about 130°, two different series of action and products are observed; among these, triethylsulphine-platinchloride was obtained—

$$\left.\begin{array}{l} \overset{I}{C_2H_5} \\ \overset{I}{C_2H_5} \\ \overset{I}{C_2H_5} \\ Cl \end{array}\right\} S_3PtCl_2\,;$$

also ethylen-diethylsulphine-platinum-chloride -

$$\left.\begin{array}{l} \overset{II}{C_2H_4} \\ \overset{I}{C_2H_5} \\ \overset{I}{C_2H_5} \\ Cl_2 \end{array}\right\} S_2PtCl_2$$

also trimethylsulphine-bromide, C_3H_9SBr. In 100 parts—Carbon, 22·93; hydrogen, 5·75; sulphur, 20·38; bromine, 50·96. The paper enters into a lengthy discussion on the labours of MM. Cahours, Kolbe, and others on this subject.

Calculation of the Heat Emitted by the Combustion of Organic Compounds.—M. Thomsen.

Contribution to the History of the Salicylic Compounds.—M. Henry.—This is the third portion of a memoir on this subject, subdivided into the following sections:—Nitrile of salicylic acid—

$$C_6H_4\left\langle\begin{matrix}HO\\CN\end{matrix}\right.$$

Nitrile of benzoyl-salicylic acid—

$$C_6H_4\left\langle\begin{matrix}(C_7H_5O)O\\CN\end{matrix}\right.$$

Metachlorobenzonitrile—

$$C_6H_4\left\langle\begin{matrix}Cl\\CN\end{matrix}\right.$$

Metachloronitrobenzonitrile—

$$C_6H_3(NO_2)\left\langle\begin{matrix}Cl\\CN\end{matrix}\right.$$

New and General Method for the Formation of Nitriles.—M. Henry.—The concluding portion of a long essay on this subject.

Some Sulphuretted Compounds of Isopropyl.—M. Henry.—This paper treats of:—Sulphocyanide of isopropyl, $C_3H_7.CNS$, a fluid of 0·963 sp. gr. at 20°, boiling at about 150°. Sulphur isopropyl, $(C_3H_7)_2S$, boils at 105°, and enters into combination with several metallic chlorides, the mercurial compound being a crystalline substance of the following formula:—$(C_3H_7)_2S.HgCl_2$. Mercaptanisopropyl, $(C_3H_7)HS$, boils at 45°, and acts energetically on peroxide of mercury, yielding a crystalline compound, $(C_3H_7)_2HgS_2$; the alcoholic solution of this substance yields, with salts of lead, yellow-coloured precipitates, with acetate of copper a white-coloured precipitate, and the same with solutions of the salts of peroxide of mercury.

Some Derivatives of Oxybenzoic Acid.—M. Heintz.—The author describes the following substances:—A diethyl-ether—

$$C_6H_4.OC_2H_5.COOC_2H_5,$$

a clear, colourless, oily liquid, boiling at 263°; its sp. gr., at 20°, is 1·0725; at 0°, 1·0875; its co-efficient of expansion is 0·000735. On saponification, this ether yields an acid $C_6H_4.OC_2H_5.COOH$, a solid substance fusing at 137°; it yields salts with potassa, baryta, lime, and oxide of silver. Acetoxybenzoic acid, $C_6H_4.OOCCH_3.COOH$, a solid fusing at 127°, readily yielding salts with alkalies and the alkaline earths. Oxybenzoic-monethyl-ether, a fluid; formula—

$$C_6H_4.OH.COOC_2H_5;$$

freezes at − 12°, but does not become fluid again until at 72°. (All the formulæ here quoted are exactly reproduced from the original.)

Action of Chloride of Mercury upon Sulphocarbanilide and Sulphocarbotoluide at a Higher Temperature.—M. Buff.—After referring to the experiments of MM. Merz and Weith on this subject, the author says—When a mixture of finely-powdered chloride of mercury and sulphocarbanilide is heated to about 150°, the mixture first fuses, next begins to give off a quantity of hydrochloric acid and sulphuretted hydrogen gases, and after the lapse of many hours the mass exhibited the odour of phenylsenfol (phenylated essential oil of mustard); while in the neck of the retort some crystals of hydrochlorate of aniline were found. The mass in the retort was first treated with boiling water, and next with alcohol, leaving a residue of mercury and sulphur; by this process a basic substance, soluble in water, was obtained, which has been called tricarbohexamide by MM. Merz and Weith, and triphenyl-guanidine by Prof. A. W. Hofmann. This substance fuses at 145°; when it is heated with sulphuric acid, sulphanilic acid is formed. The alcoholic solution yielded a solid crystalline matter, fusing at 235°, and exhibiting all the characteristics of a phenylated urea. When sulphocarbotoluidide is treated in the same manner, but at a temperature between 165° and 180°, a mass was obtained which exhibited a strong odour of oil of aniseed; the mass was at once exhausted with alcohol, yielding, after a complex process of purification, crystals of tritolylguanidine and sulphocarbotoluidide. The formation of tritolylguanidine is explained by the following formulæ:—

$$CH_3-C_6H_4\left.\begin{matrix}\\H\end{matrix}\right\}N-\underset{\underset{N}{\|}}{C}-N\left\{\begin{matrix}C_6H_4-CH_3\\ \|\\ C_6H_4-CH_3\end{matrix}\right.$$

A New Phosphamide.—M. Wichelhaus.—After referring to the labours of MM. Fittig, Gerhardt, Kekulé, and others, the author points out that, when phosphorus perchloride acts upon benzol-sulphamide, the product of that reaction need not be, as is generally supposed, benzol-sulphamide-chloride. On repeating the experiment, the author obtained, by means of a complicated set of reactions, a substance, $C_6H_5O_2NPCl_2$; the reaction should, therefore, be represented by the following formula:—

$$C_6H_5.SO_2NH_2+PCl_5.Cl_2=Cl_2+HCl+C_6H_5.SO_2NHPCl_2.$$

The substance resulting from the benzolsulphamide appears to be a phosphamide, and is called by the author *benzol-sulphurylbichlorphosphamide*—

$$\begin{matrix}NH(C_6H_5.SO_2)\\PCl_2\end{matrix}$$

Under the title of "Correspondence," M. V. von Richter writes from St. Petersburgh as follows:—The study of chemistry and the number of scientific chemists has of late years so rapidly increased in Russia that, after a general meeting of scientific men of the empire (held at the capital, in January, 1868), the Government permitted (on the 28th of October of that year) the establishment of a Chemical Society for the empire, upon the conditions that the seat of the Society should be the capital city, and that none but really scientific chemists should be elected as members. The president of the Society is elected for five years consecutively, and this office is held by M. Zinin. The meetings take place monthly, except the three summer months; at the meeting of 11-23 September last the following communications were made:—

Action of Iodine upon the Silver Compound of Succinimide Dissolved in Acetone.—M. Menschutkin.—Iodine of succinimide is obtained in crystals belonging to the quadratic system; at 153°, this substance is decomposed, succinimide being again formed. Iodine does not act upon the sodium combinations of formanilide and acetanilide.

Benzimide.—M. Zinin.—The author states that when this substance (formula, $C_{28}H_{14}N_3O_2$) is heated, along with water, in sealed tubes, it is split up into oil of bitter almonds and the amide of an acid as yet not well determined.

Nitrotoluol.—MM. Beilstein and Kuhlberg—The authors exhibited a series of preparations of this substance; among these, solid nitrotoluol, boiling at 237°, and fluid nitrotoluol, boiling at 221°. The latter yields fluid isotoluidine.

Preparations of Thymol.—MM. Engelhardt and Latschinoff.—When thymol is acted upon by anhydrous phosphoric acid, propylen and γ cresol is formed. This latter substance differs from α and β cresol, which are obtained from two toluol-sulpho acids; but the boiling point of these three cresols is 190°. This concludes the correspondence from St. Petersburgh.

On Ethylenterrochloride.—M. J. Kachler.—When an ethereal solution of chloride of iron is heated for some hours in a sealed tube up to about 150°, a solid greyish-coloured substance is obtained. The author finds that this substance is, after having been purified, a compound

$C_2H_4.Fe_2Cl_2 + 2H_2O$. The formation of this substance is represented by the following formula:—

$$\left.\begin{matrix}C_2H_5\\2C_2H_5\end{matrix}\right\}O + 2Fe_2Cl_3 = 2(C_2H_4.Fe_2Cl_2) + 2\left.\begin{matrix}C_2H_5\\H\end{matrix}\right\}O + 2Cl.$$

This compound is not formed when the ether is perfectly anhydrous, and could not be obtained when, instead of ether, alcohol was used.

Balsam of Peru.—M. Kachler.—The author first reviews the labours of the large number of scientific men who have taken up and investigated this subject; and next describes, at very great length, his experiments, which gave, as result, that 100 parts of this balsam consist of 20 parts of benzile alcohol, 46 parts of crude cinnamic acid, and 32 parts of resin. There is appended to his paper a critical review of the labours on this same subject recently published by M. Delafontaine, from which it appears that the Peru balsam of commerce is a substance of variable composition, as has been very frequently brought forward and proved by scientific as well as pharmaceutical chemists.

Some Derivatives of Succinyl.—M. Weselsky.—The author describes:—Succinyl-phenol—

$$\left.\begin{matrix}C_4H_4O_2\\2(C_6H_5)\end{matrix}\right\}O_2,$$

is insoluble in water; soluble in ether, sulphide of carbon, and benzol; fuses at 118°; and boils and distils over, without decomposition, at 330°. Sulpho-succinate of potassa—

$$\left.\begin{matrix}C_4H_4O_4\\K_2\end{matrix}\right\}S_2,$$

is a solid substance, readily soluble in water, alcohol, and ether, and readily decomposed by acids, sulphuretted hydrogen being evolved. Sulpho-succinic acid, $C_4H_4O_2S$, also called sulpho-succinyl, is very soluble in water, alcohol, and ether, and exhibits a strongly acid reaction; with solutions of salts of copper, it is immediately decomposed, sulphide of copper being formed.

On Biniodide of Phenol.—MM. Hlasiwetz and Weselsky.—In the introduction to this paper, the authors review the history of some isomeric monoiodine phenols, and other compounds of phenol and iodine. Pure biniodide of phenol is a crystalline substance, readily soluble in alcohol, ether, and sulphide of carbon; fusing at 150°; subliming at a higher temperature; formula, $2C_6H_4I_2O + 2H_2O$.

Products of the Oxidation of Toinol-Sulpho Acid by means of Fusing Caustic Potassa.—M. Barth.—This paper, and the next (by the same author).—

Constitution of Phloretinic Acid and Tyrosine—Are not well suited for abstraction.

On Sulphoxybenzoic Acid.—M. Senhofer.—By a lengthy process, too long for quotation, the author obtained sulphoxybenzoic acid in pure state. It is a crystalline bright green-coloured substance, $C_7H_2SO_6$, not precipitated by neutral acetate of lead, and yielding, with chloride of iron, a wine-red colour; at 160°, it loses water; the acid fuses at 208°. This acid forms compounds with lead and cadmium; the latter is an acid salt. Formula, $2(C_7H_2SO_6)Cd$. The acid does not readily form salts with alkalies.

New Mode of Formation of Protocatechuic Acid.—M. Malin.—The author finds that, when sulphanisic acid is heated with fusing caustic potassa in excess, care being taken to regulate the temperature properly, and to avoid a too long continued action of the potassa, the result is the formation of protocatechuic acid; when the action is too long continued, hydrochinon is, however, formed. The acid obtained was found, on elementary analysis, to yield—C, 54·7; H, 4·0. Dried at 100°, this substance lost 10·5 per cent of water. The quantity of protocatechuic acid obtained from 16·6 grms. of sulphanisic acid amounts to about 2 grms.

Pettenkofer's Method for the Determination of Carbonic Acid.—Dr. Gottlieb.—The author states that while, with the method alluded to, the accuracy thereof mainly depends on the care taken in the preparation of the turmeric paper used in this process (which is not described, but understood to be generally known), he has found that, when proper precautions are taken, the pigment of litmus answers the purpose as well. For this purpose, the litmus is exhausted with alcohol at 85 per cent, until it only assumes a very slight violet tinge. The alcohol is removed by evaporation on a water bath, leaving behind a deep violet-coloured amorphous mass, the largest part of which is soluble in cold water, yielding a solution which, on the addition of an acid, assumes the well-known red colour, known as *rouge pelure d'oignon*, while alkalies do not affect it. The remainder of the litmus (insoluble in alcohol) is treated with water, yielding a blue pigment insoluble in alcohol; this aqueous solution is, after removal, by filtration, of the substances of the litmus insoluble in water (impurities), at first, violet-blue coloured; but this tinge changes, on the addition of more water, into a pure blue, which, by the addition of acids, soon becomes beautifully red (*pelure d'oignon*), which tinge, however, does not become apparent unless a larger quantity of acid has been added. The author, therefore, adds to a portion of the blue-coloured fluid guttatim, some very dilute hydrochloric acid, until the fluid has assumed a wine-red tinge. When this point has been reached, the rest of the blue (original) liquid is added; and in this manner a fluid is obtained which answers the purpose of working according to Pettenkofer's method, better than turmeric paper or tincture, since the author states that, on instituting comparative tests and essays, he found it easy to estimate to within 0·0007 grm. of carbonic acid.

Comptes Rendus des Séances de l'Académie des Sciences, November 15, 1869.

This number contains the following original memoirs and papers relating to chemistry and allied sciences.

Researches on the Luminous Effects Due to the Action of Light upon Different Bodies—Refrangibility of the Active Rays.—M. Becquerel.—This is the fifth instalment of a lengthy memoir on this subject. In order to study very completely the mode according to which the exciting action (*action excitatrice*) of the solar spectrum is distributed when made to illuminate bodies not possessed of any great phosphorescence, the author applies a wide-mouthed phosphoroscope. The substance to be investigated is reduced to a fine powder, and fixed, by means of a little gum-water, to a plate of mica. The author's experiments led to the following conclusions:—The most refrangible rays, and principally those beyond the violet, are the most active; the different parts of the solar spectrum differ in their activity; the least refrangible rays from the blue, and past the ultra-red, act especially as extinguishers of phosphorescence.

Petroleum in the Netherlands' East Indies.—Dr. von Baumhauer.—The author gives a complete description of a large number of sources of petroleum discovered in different islands of the Indian Archipelago, which are dependencies of the Netherlands. The author states that, from observations and experiments made, there exists, at 250 metres' depth, an almost inexhaustible reservoir of this fluid.

Facts Relating to Inverted Sugar.—M. Maumené.—The so-called inverted sugar is prepared by the author in the following manner:—Perfectly colourless sugar-candy is pulverised and thoroughly washed, first, with pure ether, and then with perfectly pure absolute al-

cohol; the powder is next dissolved in about five times its weight of very puro distilled water, to which is added 1 c.c. of puro concentrated hydrochloric acid (this quantity of acid is sufficient for the conversion of 1 kilo. of pure sugar). The aqueous solution is heated on a water-bath for a few hours, until colouration just begins to be perceptible. The HCl is removed, by the quantity of oxide of silver required for that purpose, with only five milligrms. excess; the chloride of silver is separated by filtration: the filtered liquid treated with sulphuretted hydrogen, to make perfectly sure of the removal of all metal; the liquid again filtered, and next evaporated upon a water-bath, yielding perfectly pure glucose. The remainder of this paper is a critical review of M. Dubrunfaut's labours, and too lengthy to admit of any useful abstraction.

Lower Liguites of the Plastic Clay of the Paris Basin.—M. Planté.—An interesting paleontological paper.

Chemical Composition and Mode of Deposition of the Layers of the Great Oolite and Forest Marble in the Haute-Marne.—M. Guignet.—After referring, at some length, to the peculiar geological features of this portion of France, the author communicates the analysis of a peculiar kind of soil, which, in 100 parts, consists of—Silica, 50·0; alumina, 15·0; peroxide of iron, 10·0; lime, 2·5; water, 5·0; magnesia, manganese, sulphuric acid, and other non-determined substances, 17·5; the greater portion of this paper is chiefly of local interest.

Permanganic Acid.—M. Delaurier.—After briefly referring to former communications on this subject, the author states—Manganate of lime is produced by heating, with access of air, 1 equiv. of peroxide of manganese, and 1 equiv. of lime. This compound exhibits a brown colour; and when the ignition is continued, the mixture being stirred to promote the access of air, it is converted into permanganate of lime, exhibiting a blackish colour, and being more fusible than the manganate—

$$2CaO,MnO_4 + O = CaO,Mn_2O_7 + CaO.$$

This substance is a powder; and when the author tried to set free permanganic acid from it, by means of two equivs. of sulphuric acid diluted with some water, the heat thereby disengaged is too great, and the permanganic acid is decomposed into sesquioxide of manganese and oxygen; but when fused permanganate of lime is applied, the action of the sulphuric acid is slow, and the permanganic acid may be obtained by distillation at a temperature of from 60° to 70°.

This number contains several papers relating to meteorology and luminous meteors—among these, a lengthy account, accompanied with an engraving, of a bolide and its explosion, observed by M. J. Silbermann on the 11th inst., at nearly 11 p.m.

Annalen der Chemie und Pharmacie, October, 1869.

This number contains the following original papers and memoirs:—

Researches on the Essential Oil of the Fruits of Heracleum Spondylium.—M. Zincke.—The essential oil was obtained by distilling, with water the fruits of the *Heracleum spondylium*. 80 lbs. of the fresh fruits yielded 120 grms of oil; the water which came over with the oil exhibited a very strongly acid reaction to test paper, and was, therefore, also subjected to investigation. The essential oil which was obtained was of a bright green colour, very fluid, and exhibited only a slight smell, which was rather pleasant; its taste was burning and acrid; sp. gr. at 20°, 0·864; slightly acid reaction to test paper; did not yield, when treated with a concentrated solution of bisulphite of soda, any crystalline substance (stearopten); submitted to fractional distillation, there were obtained two portions—one (about 14 grms.) came over at from 190° to 195°, the other portion (of about 40 grms.) came over at 200° and 203°. This last portion exhibited a perfectly clear neutral fluid, insoluble in water, but miscible with alcohol and ether; sp. gr. at 16°, 0·8717; formula, $C_8H_{18}O$. This portion of the oil turned out to be, on further investigation, an octyl-alcohol; formula, $C_8H_{18}O$. The following derivatives of octyl-alcohol were investigated:—Chloroctyl, $C_8H_{17}Cl$; bromoctyl, $C_8H_{17}Br$; iodoctyl, $C_8H_{17}I$; octylic acid-octyl ether, $C_8H_{17},C_8H_{16}O_2$; benzoic acid-octyl ether, a colourless fluid, exhibiting an aromatic odour, boiling at about 306°, insoluble in water, but readily soluble in alcohol and ether. The investigation of the first portion of the oil (boiling between 190° and 195°) proved it also to contain an octyl-alcohol, but along with it some substances the nature of which could not be ascertained with certainty. The acid-water above alluded to was found to contain acetic and capronic acids.

Synthesis of a Hydrocarbon of Ethyl-Vinyl Isomeric with Butylen.—M. Wurtz.—In order to prepare hydrocarbons synthetically, the author causes zinc ethyl to act upon organic bromine or iodine compounds. Zinc ethyl and bromated ethylen are mixed, and heated to 140° in sealed tubes, and next left standing for several weeks. Previous to opening the tubes, these should be placed in freezing mixture, and the gas which is given off when the tubes are opened is made to pass into bromine. The bromated compound thus obtained is a perfectly clear liquid, boiling at 166°; sp. gr., 1·876. When this bromated compound is treated with sodium, ethyl-vinyl is set free; this substance is a fluid boiling at −5°.

Researches on the Constitution of Piperine and its Products of Decomposition, Piperinic Acid and Piperidine.—MM. Fittig and Mielch.—This memoir, of which the first instalment is here given, is divided into the following sections:—1. Preparation and properties of piperinic acid.—This acid is prepared by gently boiling, for about twenty-four hours, a mixture of 1 part of piperine, 1 part of caustic potassa, and 5 parts of alcohol, yielding piperinate of potassa. The authors have tried to split up piperine by means of hydrochloric acid; this method, however, proved unavailable, since there were by-products formed which destroyed nearly all the piperinic acid. Piperinic acid, when pure, is a colourless solid substance, fusing between 212° and 213°; when submitted to distillation along with excess of lime, phenol is among the products of the decomposition. 2. Experiments made in order to solve the question whether piperinic acid contains HO or CH_2O,C_2H_2O, etc.—From the lengthy series of experiments instituted by the authors, the conclusion is that piperinic acid is a monobasic as well as a monatomic acid. 3. Products of the oxidation of piperinic acid.—(*a*) Behaviour of piperinic acid towards chromic acid. (*b*) Behaviour of piperinic acid with permanganic acid in neutral solution. Piperonal is one of the chief products of the oxidation of piperinic acid; formula of piperonal, $C_8H_6O_3$. Piperonylic acid, $C_8H_6O_4$, stands in the same relation to piperonal as benzoic acid to oil of bitter almonds. (*c*) Action of nascent hydrogen gas upon piperonal and piperonylic acid. (*d*) Piperinic acid and nitric acid. 4. Action of bromine upon piperinic acid. 5. Hydro-piperinic with oxidising substances and bromine.

Researches on the Creosote obtained from Rhenish Beech-Wood Tar.—M. Marasse.—From the introduction to this paper, we learn that there exists some difference between the creosote obtained from beech-wood grown along the Rhine and that grown in a portion of Southern Germany. Both kinds of creosote contain guaiacol, $C_7H_8O_2$, and cresol, $C_8H_{10}O_2$, and, moreover, in addition thereto some other substances not containing oxygen. The author's researches on the Rhenish beech-wood tar prove that there are contained in that liquid—guaiacol, cresol, phenyl-alcohol, and substances homologous therewith. The lengthy essay is divided into the following sections:—(*a*) Researches of the fluids boiling below 199° (the raw material operated on was a rectified creosote of commerce of excellent quality, manufactured by MM. Dietze and Co.,

[English Edition, Vol. XX., No. 622, pages 262, 263.]

operative chemists, at Mainze); (*b*) action of powdered zinc upon creosote boiling between 200° and 203°; (*c*) action of fusing caustic potassa upon creosote of the same boiling point; (*d*) action of hydrochloric and hydriodic acids upon that same creosote; (*e*) preparation of the methylic ether of cresylic alcohol and of the neutral methylic ether of pyrocatechin; (*f*) action of hydriodic acid upon creosote boiling at between 217° and 220°; (*g*) action of hydrochloric acid and chlorate of potassa upon guaiacol; (*h*) action of the last-named chemicals upon creosote boiling at between 200° and 203°. The author of this paper adds a foot-note, of the following purport:—It is generally taken for granted that the use of chromate of lead, in the elementary organic analysis, is preferable to that of oxide of copper whenever the complete combustion of difficultly-combustible substances has to be provided for; but the author found that in the case of cresylic alcohol (even when a current of oxygen is made to pass through the combustion-tube towards the end of the operation), its complete combustion is impossible. As the cause for this phenomenon, the author assigns the fact that a portion of the chromate of lead is entirely reduced to the metallic state, and that this lead retains carbon, preventing its combustion. It is, perhaps, not out of place here to observe that this same observation was made about thirty years ago by the late Berzelius, who therefore advised the admixture of pure and carefully-fused bichromate of potassa in small quantity to the chromate of lead.

Products of the Oxidation of Toluol-Sulpho Acid by Fusing Caustic Potassa.—M. Barth.—The author obtained, by this reaction, paraoxybenzoic acid, salicylic acid, cresol, and other substances. Paraoxybenzoic acid fuses at 210°, and crystallises in prismatic-shaped large white-coloured crystals; formula, $C_7H_6O_3+H_2O$.

Constitution of Phloretinic Acid and Tyrosine.—M. Barth.—When phloretinic acid is submitted to fusion along with excess of caustic potassa, the author obtained a substance, $C_7H_6O_3+H_2O$. On further investigation of this subject, the author came to the conclusion that there exist two acids—

$$C_6H_4 \begin{cases} OH \\ C_3H_5O_2 \end{cases}$$

each of which yields, on becoming oxidised, paraoxybenzoic acid. Tyrosin, when pure, also yields, on fusion with caustic potassa, the same acid. The theoretical reasonings of the author, concerning the constitution of tyrosine—

$$C_6H_3 \begin{cases} OH \\ NH.C_2H_5 \\ COOH \end{cases}$$

are too abstruse to be suitable for abstraction.

Decomposition of Acetate of Silver under the Influence of Iodine and a High Temperature.—M. Birnbaum.—After reviewing the labours of MM. Weltzien, St. Claire-Deville, Bourgoin, and others who have experimented on this subject, the author states that he obtained, by causing iodine to act upon acetate of silver, chiefly two substances—viz., a fluid, and a mixture of gas, chiefly carbonic acid; the fluid is acetic acid, while among the gases ethyl and acetylen could be readily detected. When the rather violent reaction is moderated, the author found that the following products are formed:—Iodide of silver, acetate of methyl, acetic acid, carbonic acid, acetylen, hydrogen, and sometimes silver and carbon. The quantities of these substances vary considerably, and it is the author's opinion that this should indicate that several reactions are going on at the same time. The reaction may be represented by the following formula:—

$$2CH_3COO.Ag+I_2=CH_3COOH+CH_3I+CO_2+2AgI;$$
$$2CH_3I=C_2H_2+H_2.$$

Acetate of silver, when in aqueous solution, behaves with an aqueous solution of iodine in a different manner, and the reaction is expressed by the following formula:—

$$6C_2H_3AgO+6I+3H_2O=6C_2H_4O_2+5AgI+AgIO_3.$$

On Sulphate of Amarine.—M. Groth.—The author first refers to M. Laurent's researches on this subject, and then says that he could only experiment with a very small quantity of the above-named substance, which had been forwarded to him more for crystallographical than for chemical research. Sulphate of amarine is tolerably soluble in water; its water of crystallisation is driven off at about 110°; composition, $2(C_{21}H_{19}N_3)2SO_4+7aq$.

Formation of Phenols when Chloride of Zinc Acts upon Camphor.—M. Rommier.—According to the late M. Gerhardt camphor is converted into cymen and water by distillation with chloride of zinc, according to the formula $C_{20}H_{16}O_2=C_{20}H_{14}+2HO$. Very many experimenters—among them, MM. Lippmann, Longuinine, Fittig, &c.—have found it either impossible, or, at least, very difficult, to obtain this result. The author states that he operated with 2 kilos. of camphor, and obtained about 700 grms of a volatile oil boiling between 140° and 240°; this oil proved to be a mixture of various substances, among which were cresyl-alcohol, several hydrocarbons, and other products of decomposition, due rather to the high temperature than to the simple elimination of water by the chloride of zinc and high temperature together.

Conversion of the Butyric Acid of Fermentation into Normal Primary Butyl-Alcohol, and into Ordinary Butyl-Alcohol as obtained by Fermentation.—M. Linnemann.—This is only a brief preliminary notice written *pour prendre date*.

Cosmos, November 13, 1869.

This periodical contains the following original papers and communications:—

Estimation of Nickeliferous Iron in Meteoric Stones.—M. Meunier.—There are three methods chiefly in use for this purpose—viz., separation of the metal by means of a magnet; solution of the metal in a solvent, which leaves the remainder of the material composing the stone untouched; and the measuring of the hydrogen set free by the solution of the metal in a confined space. The author has added to these methods of estimation another, which he describes as follows:—When the meteorite to be investigated is very finely pulverised in an agate mortar, there is added to it an excess of a solution of chloride of gold in water, the iron (present in the form of minute particles) is rapidly dissolved, and there is formed a precipitate of metallic gold equivalent to the quantity of iron present. The solution of the iron takes place rapidly, so that after a few minutes the operation is complete. The contents of the small flask wherein the operation took place are placed on a filter and thoroughly washed with water until the excess of chloride of gold is washed out. When this point has been arrived at, the remainder upon the filter is washed with moderately dilute hydrochloric acid, in order to remove the last traces of any chloride of gold adhering to the stony matter of the meteorite; this having been done, the residue on the filter is removed to a small flask, and therein treated with *aqua regia* (nitro-hydrochloric acid), and the quantity of gold estimated in the liquid by well-known methods. By multiplying the weight of the gold thus obtained by the rapport of the equivalents of gold and iron, that is to say, by—

$$\frac{28}{98{\cdot}18}=0{\cdot}286$$

the weight of nickeliferous iron is obtained. The author states that he has tested this process, and compared it with the others above alluded to, and found it to yield very correct results.

Quino-Picric Acid.—MM. Duguet and Perret.—A golden-yellow coloured substance, exhibiting a very bitter taste, difficultly soluble in water, but readily in alcohol;

also soluble in ammonia and the aqueous solutions of alkalies, without decomposition; not perceptibly acted upon by daylight and air when placed in closed bottles. When projected on burning coals, this substance burns off like lycopodium, but does not detonate; on being ignited on platinum foil, no residue is left if the substance is pure. The composition of this material, which is applied as a febrifuge, is stated to be, in round numbers—Alkaloids, 58; picric acid, 42. It is manufactured by acting with picric acid upon those alkaloids of the *cinchonæ* species (viz., quinidine, quinicine, cinchonine, cinchonicine, &c.), which are not used as medicine by themselves, and, in a sense, valueless.

Annalen der Physik und Chemie, von Poggendorff, No. 10, 1869.

This number contains the following original papers :—

Thermo-Chemical Researches.—M. Thomsen.—This is the second instalment of a lengthy memoir. This portion treats of the hydracids of chlorine, bromine, iodine, fluorine, and cyanogen.

Combinations of Alcohol and Water.—M. Mendelejeff.—The second and concluding part of a very lengthy essay on a subject which is of very great importance, both in a scientific and practical point of view, in consequence of the excise duty on spirits. In this portion of the paper, a chapter is devoted to absolute alcohol. After referring to the discrepancies of the specific gravity of that fluid, as determined by different experimenters, the writer proceeds to state that he has reviewed this subject entirely, taking care to obtain alcohol chemically pure (a far more difficult problem than is generally believed); next, also, avoiding, or, at least, taking into account, the very rapid absorption of water and air (absolute alcohol absorbs air readily—100 volumes of that fluid absorb, at 15°, and 760 m.m. barometer, 10·1 volumes of nitrogen and 6·3 volumes of oxygen). The author found the specific gravity of pure absolute alcohol to be 0·79845 at $\frac{20°}{4°}$ C. In order to dehydrate the alcohol, the following substances were tried:—Potassa, chloride of calcium, dried sulphate of copper, anhydrous oxide of barium, sodium-amalgam, and quicklime; the latter is the substance best suited for that purpose. The paper further contains chapters on the contraction of mixtures of alcohol and water, and on the changes of specific gravity of mixtures of alcohol and water.

New Sulpho-Salts.—M. Schneider.—Sulphide of silver and sulphide of iron, $Ag_2Fe_2S_4$; in 100 parts—Silver, 47·38; iron, 24·56; sulphur, 28·06. This compound exhibits the following properties:—Iron-grey coloured shiny crystalline needles, unaltered in dry air, but becoming rapidly rust-coloured when exposed to moist air; not acted upon by very dilute hydrochloric acid, but becoming rapidly decomposed by the action of stronger acid, sulphuretted hydrogen becoming evolved. Heated in a dry glass tube, this compound fuses, and vapours of sulphur are given off, leaving a residue consisting of protosulphuret of iron and metallic silver. Sulphide of sodium with sulphide of iron, containing water, $Na_2Fe_2S_4+4H_2O$; in 100 parts—Sodium, 12·43; iron, 31·07; sulphur, 35·44; water, 19·58. Sulphide of sodium with sulphide of bismuth, $Na_2Bi_2S_4$; in 100 parts—Sodium, 7·79; bismuth, 70·51; sulphur, 21·70. Cuprosulphide of sulphide of potassium with sulphide of copper, $K_2Cu_4S_6$; in 100 parts—Potassium, 10·05; copper, 65·27; sulphur, 24·68. Disodium-cuprosulphide with sulphide of copper, $Na_4Cu_6S_6$; in 100 parts—Sodium, 13·84; copper, 57·29; sulphur, 28·87. Potassic-sulphide of iron with sulphide of copper, $K_2FeCu_2S_4$; in 100 parts—Potassium, 17·28; iron, 12·37; copper, 42·08; sulphur, 28·27. Ferro-sodium sulphide of copper with sulphide of copper, $Na_2FeCu_2S_4$; in 100 parts—Sodium, 10·94; iron, 13·32; copper, 43·50; sulphur, 30·44.

Emission and Absorption of the Heat-Rays Emitted by Bodies at Lower Temperatures.—M. Magnus.—The main points of this paper are:—Different bodies, heated to 150°, emit different kinds of heat; some substances only emit one kind of heat—others, again, various kinds. Pure rock-salt is monothermic; sylvin (chloride of potassium) behaves in a similar manner.

MISCELLANEOUS.

The City of London Gas Act.—We have received from Dr. Letheby his report on the results of the daily testings of the gas supplied to the City during the quarter which ended on the 30th day of September last, from which we find that the maximum illuminating power of the Cannel gas supplied by the City of London Gas Light and Coke Company has been equal to 27·50 standard sperm candles, the minimum to 19·50 candles, and the average to 24·58. The gas supplied by the three companies has been free from sulphuretted hydrogen, but the proportions of sulphur have fluctuated to a large extent. Ammonia has also been found in the gas supplied by the Chartered Company. The use of Sugg's New London Argand Burner of 24 holes shows an increase of illuminating power of sixteen per cent.

University of London.—The following are lists of the candidates who have passed the Second B.Sc. Examination:—*Pass Examination.*—First Division. William Henry Johnson, University College; Alexander Muirhead, University College; William Stephen Ridewood, B.A., private study. Second Division. Phineas Simon Abraham, Trinity College and Royal College of Science, Dublin; William Barnett Burn (First M.B.), St. Bartholomew's Hospital; Dan Isaac Davies, private study; Septimus Peché Moore, LL.B., New and University Colleges; Frederic James Montague Page, Royal School of Mines; Frederick Antony Potter, Royal School of Mines; Charles Thomas Whitmell, St. John's and Trinity Colleges, Cambridge; William Henry Willans, University College and Royal School of Mines.

Production of Oxygen Gas.—Five hundred pounds of manganate of soda furnish two and a half cubic yards of oxygen every hour. This charge is placed in a retort, and superheated steam passed over it; in *five minutes* all the oxygen is extracted from this quantity of the salt. Hot air passed over this residue for *five more minutes* restores all the oxygen given up, and the result of an hour's continuous work, or six extractions of oxgen and six re-oxidations, is two and a half cubic yards of oxygen. This oxygen, when it issues from the gasometers, contains about fifteen per cent of nitrogen, but, by letting the first portions escape, the quantity of this mixture can be reduced to two and a half per cent. M. Tessie du Mothay affirms that one ton of manganate of soda will yield one hundred cubic yards of oxygen daily, or more than 36,000 per year, *and this without having to renew the salt once.*—R. J. Fowler, *in the British Journal of Photography.*

Obituary.—We regret to have to record the death of Dr. Frederick Penny, the Professor of Chemistry in the Andersonian Institution, to which chair he was elected in July, 1839. His published papers and researches, as well as his great success as a teacher of chemistry in Glasgow, testify to his ability as a chemist and physicist; and his loss will be felt by a numerous circle of students and friends.

NOTES AND QUERIES.

Halliday's Machines.—"A. W. N." will find, we think, the information he desires in Richardson's, Knapp's, and Watts's work on "Chemical Technology."

Tungstate of Soda, &c.—(Reply to "J. C.")—This article is not manufactured in such large quantities as to require special makers—some few manufacturing chemists make it, and also the tungstate of chromium; but we cannot name any who do so continually. If "J. C." wants these articles, he should either apply to those who sell chemicals, or to some manufacturing chemist, whose names can be found in directories.

[English Edition, Vol. XX., No. 522, page 264; No. 519, page 224; No. 520, page 237; No. 521, page 248; No. 522, page 262; No. 519, page 228.]

Footpaths.—"Roadway" will find one part of Portland cement, mixed with seven or eight parts of gravel, or old hard durable rubbish, such as brick bats, broken stones, or gravel, to make a cheap, neat, permanent, garden walk, impervious to wet, heat, or cold. I will give your correspondent any information he needs if he sends his address to me through you.—Nemo.

Footpaths.—(Reply to "Roadway.")—Your question is one which belongs to civil engineering, rather than chemistry; you do not state a very important item—viz., the natural soil you wish to make a footpath on. A very good and, comparatively, cheap footpath may be made by laying down, first, a layer of rather coarsely broken-up old bricks, next, some middling coarse gravel, and over that a layer of from 2 to 4 inches thickness of small sea-shells (bivalves). If care be taken to beat or roll the broken-up bricks and gravel well into a solid mass, the shell-covered surface may be advantageously rolled in with a heavy iron roller, and will be found to form, even on soft sub-soil, a durable and inexpensive roadway. On the continent, at least in Belgium and the Netherlands, many roadways, *chemins vicinaux et communaux*, are thus arranged, and stand moderate horse and carriage traffic admirably well. Care should be taken for the proper drainage of such roads.

Bichromate of Potash.—In answer to "Bichrome," in your last number, this article is made by Norris, Brothers, Sowerby Bridge, near Halifax; The Conacher Quay Chemical Company, 121, Newgate Street, London; by a Company at Drontheim, in Norway; and also at Baltimore, U.S. If your correspondent wants further information, and writes to me under cover to you, I will ascertain the other addresses.—Nemo.

Terra Alba.—"Selenite" thanks "Nemo" for information given and offered, and would ask further—Is any particular variety of gypsum preferred? what is the nature of Jullien's process? what precipitation is meant? how is drying effected? is the patent English? Also—If the purest gypsum answers, why the artificial product? what is the difference in cost of production of native and artificial? why is French better than English terra alba? any objection to mention uses of material?

By-Products Containing Soluble Phosphates.—Will any of your correspondents give information as to where any by-products can be obtained containing 3 per cent and over of soluble phosphate?—Arthur Warner.

Preventing Moisture in Glass Cases.—Wishing to enclose a philosophical instrument in a second outer case of glass, where moisture is an enemy, can any correspondent inform me which is the best material to use, chloride of calcium, quicklime, $HO+SO_3$, dehydrated alcohol, or a small stick of sodium (to be scraped occasionally)?—S. E. P.

Bisulphite of Lime.—How is the "bisulphite of lime solution" which is now largely sold, possessing as high a gravity as 1·072, practically made?—A. N. Palmer.

Shoddy.—Can any of the subscribers of your valuable journal inform me the best means of rendering shoddy by acid, for mixing with phosphatic material as a manure.—Child.

Preventing Moisture in Glass Cases.—(Reply to "S. E. P.")—Use quick-lime, which absorbs both moisture and carbonic acid, and put in the case a piece of camphor wrapped in muslin, and you will not be troubled with moisture.

Standard Verification.—(Reply to "S. E. P.")—We believe that a polite application to the Astronomer Royal would obtain you what you desire; there is no doubt that at the Observatory they have the means as well as the good-will to give every assistance for such objects.

Bleaching Syrups.—(Reply to "Andrew Van Bibber.")—You can hardly expect to attain your object at all, since the colour of these syrups is due, in the first place, to caramel, and also to peculiar impurities, from which the sugar is only liberated by a process of washing with a very concentrated, and quite colourless, syrup made on purpose from best refined sugar. Filtration through charcoal (animal) will decolour these green syrups, as they are technically called, to a limited extent, and then only after having been somewhat diluted with hot water, and the filtration taking place in a room where the temperature should not be less than 80° F. By means of very finely divided pipe-clay, add 1 previous to filtration, you may obtain a greater degree of decolouration, but it is impossible to bleach, as you call it, these syrups entirely, and since you have to dilute with water before filtration, you would have to evaporate that water afterwards, and unless that were done in a vacuum pan, your previous operations would be of little avail.—X.

Detection of Prussian Blue in Black Ink.—Prussian blue is either neutral or basic. Neither of these are soluble in water; for, although it is stated that the basic blue is soluble therein, this is incorrect, since the apparent solubility is due to an excess of the ferrocyanide of potassium. There is no means of dissolving Prussian blue but by the use of acids, which would altogether destroy, and be incompatible with, black ink as usually made, since these acids are just those which are used to obliterate the stains of black ink. Prussian blue is decomposed by alkalies; but these would also destroy ordinary black ink. It is not very likely that ink should be tinged blue by Prussian blue; it is probably coloured blue by a few drops of indigo carmine. As to the detection of logwood in ink, it should be borne in mind that almost all black inks are partly made with logwood, and that a tolerably good black ink is made of logwood decoction and neutral chromate of potassa. The detection of logwood is based upon the reactions of hematoxyline and hæmateine, but the details thereof are too lengthy to be here quoted, and can be found in works on organic chemistry.

Terra Alba.—In further reply to "Selenite," it depends upon what purpose he intends or wishes to apply it—which variety is to be preferred. Chemically, they are all the same, except that the commoner kinds contain more or less foreign matter, such as oxide of iron, &c., The best kind is carefully picked out and ground into what is technically termed "terra alba," and by some people "pearl white;" this portion is so white that it looks like good loaf-sugar. The more coloured varieties, or parts of the vein (*i. e.*, the pieces rejected as unfit for terra alba), are ground up separately, and are technically called gypsum. These kinds need no drying; but when either kind is baked, so as to lose its water of crystallisation, it becomes the setting plaster, known as plaster of Paris, used by plasterers. Terra alba (*i. e.*, the natural product) is sold very much cheaper than the artificial one made under Jullien's patent. French artificial sulphate of lime is made like Jullien's, by precipitation, I think, by Prof Kuhlmann, but it is no better than native terra alba, or Jullien's pearl-hardening. As the artificial article would, if over-dried, lose parts of its water of crystallisation, it is never thoroughly dried. It is almost impossible to enumerate the many uses to which gypsum (a term which includes the whole) is applied; it is, however, largely used for manure, as an absorbent of ammonia, by colour makers, paper makers, and several other trades. Large quantities of the commoner kinds are made in Carlisle and that neighbourhood, and quantities of the stone are shipped, from the Seine, to Leith and other places, where it is ground, but the French stone is not good enough to make terra alba. If "Selenite" sends me his address, I will send him a pamphlet on the subject, containing the largest amount of information he can get about it, and which would be too much to be given through your columns. Jullien's patent is an English one.—Nemo.

Bisulphite of Lime.—(Reply to "A. N. Palmer.")—This substance is made by passing a current of sulphurous acid gas into milk of lime until a clear liquid is obtained and the lime dissolved. Care should be taken to wash the sulphurous acid.

Shoddy.—(Reply to "Child.")—Use nitric acid; this will have the effect you desire, of reducing the woody substance to a pulpy mass, converting it into xanthe-proteic acid, which is valuable as manure. By applying the acid named, you can somewhat reduce the quantity of sulphuric acid for dissolving phosphates.

Aluminium Sulphide and Phosphide.—I wish to obtain a small quantity of sulphide and phosphide of aluminium, and should feel greatly obliged if you could inform me where it is probable I could obtain them. I have tried most of the London retail houses, but without success, neither have I been successful in making these compounds, though following the methods described in Watts's "Dictionary," vol. 1, rather strictly. Perhaps you could likewise inform me where I could find the processes described in greater detail.—D. H.

The Atomicity of Aluminium.—Would some kind reader oblige an intending candidate for examination by communicating the most rational view of the atomicity of aluminium? Miller classes it as a triad, while Williamson states it to be of "even atomicity;" Roscoe called it tetratomic, but has withdrawn that assertion from his last edition. Messrs. Mottershead profess to follow Roscoe in their chemical labels, but give the symbol for alum $Al(NH_4)SO_4+12H_2O$. This, I presume, is a misprint (though still remaining uncorrected); but why should the single formula be given, instead of the double one of the books? Inquirer.

By-Products Containing Soluble Phosphates.—(Answer to "Arthur Warner.")—It is not at all likely you will meet with any such by-product, unless, perchance, in the mother liquor of phosphate of soda manufacture; but phosphoric acid is too valuable a substance to be negligently dealt with. There is a method of extracting gelatine and glue from bones, whereby the latter are first treated with a moderately strong hydrochloric acid which dissolves the mineral matter of the bone, and, consequently, contains all the phosphates thereof in soluble state; but where you could obtain such liquor we are unable to say; perhaps glue and size makers would be able to inform you.

ANSWERS TO CORRESPONDENTS.

NOTICE.—The American Publishers of The Chemical News *give notice that, in accordance with a suggestion of* Mr. Crookes, *the Editor and Proprietor of the English Publication, they will be pleased to receive and forward to him in London any scientific publications issued in America, for review—and also any Notes and Queries, Articles, Correspondence, etc., for publication or reply. Their facilities of communication with* Mr. Crookes *render this very desirable to all persons in the United States who wish to confer with him. Address to him, care of*

W. A. TOWNSEND & ADAMS,
434 Broome Street, New York.

R. Tatlock.—Communication received with thanks.

D. W. L.—Bloxam's "Laboratory Teaching," published by Churchill will answer your purpose best.

J. B.—(1) A good cement for sulphide of carbon prisms is isinglass dissolved in weak spirit. (2) Heat and good ventilation will remove the smell of wood-tar from a room.

Tallow Melter.—Please forward your address, as a letter is waiting for you at our office.

E. H. & Co.—You can learn particulars about the automatic steam-boiler feeding apparatus with constant level by writing to M. E. Leroux, 12, Rue des Beaux-Arts, à Paris.

An Old and Regular Subscriber.—Address to M. Théodore Péters, fabricant de couleurs d'aniline et d'orseille, Chemnitz, Saxony.

F. Sutton.—Received, with thanks.

Enquirer.—(1) L. Oertling, 27, Moorgate Street, E.C. (2) None but good ventilation.

M.—See Eggertz's process, given in the Chemical News a short time back.

R. R. Tatlock.—Received, with thanks.

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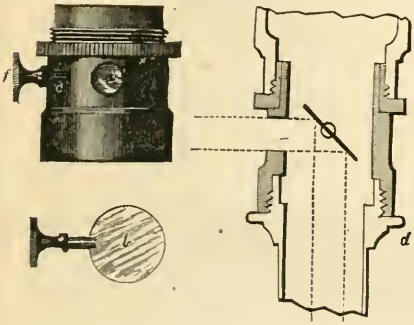
ON MICROSCOPICAL MANIPULATION.*

BY W. T. SUFFOLK, F.R.M.S.

A means of illumination adapted for use with objectives of high power, in which the space above the object is too small to admit of light being thrown upon it by any of the apparatus just described, has been contrived by Professor H. L. Smith, of Kenyon College, Ohio. He uses the object-glass itself as a condenser. A pencil of light is admitted through an aperture in the side of an adapter screwed on to the body of the microscope, which contains a small silvered mirror with suitable adjustments for reflecting the pencil downwards through the object-glass which is attached below the adapter. This apparatus was sent to Mr. E. G. Lobb, of the Royal Microscopical Society, and exhibited at the meeting in January, 1866. The instrument was placed in the hands of Messrs. R. and J. Beck and Messrs. Powell and Lealand, who each produced an improved modification. For the silvered mirror of Professor Smith they both substituted an unsilvered glass surface; that of Messrs. Powell and Lealand was a piece of parallel surfaced glass, fixed at an angle of 45°: Messrs. Beck used a disc of thin cover glass (Fig. 25, *b*), and allowed the angle to be altered at pleasure by means of a milled head, *f*, passing through the aperture, *e*. The light of a lamp is directed through the hole, *a*, in the adapter, and forms an image of the flame on the object when the object-glass is in focus. The lamp should be placed at a distance of about eight inches from the instrument; sometimes a condensing lens may be placed between the lamp and microscope with advantage. The manipulation with the instruments of both makers is precisely similar. The objects to be viewed with this illuminator should be uncovered, otherwise the cover reflects nearly the whole of the light, and scarcely any falls upon the object; some light is also lost by reflection on its passage upwards through the oblique unsilvered mirror. The impossibility of obtaining a satisfactory view of a covered object will most probably prevent this instrument from coming into very general use, although it affords valuable information to those who will take the trouble to master the difficulties attending its use.

Fig. 25.



The second class of illuminators, those which are placed beneath the stage, are also very numerous. The most familiar is the *mirror*, which forms a part of every microscope. A great variety of illumination may be obtained from the mirror alone, if properly mounted so that it may be turned considerably aside. The mirror of many microscopes is now placed on a double-jointed arm, which permits very oblique illumination to be obtained. In order to understand practically the difference caused by the position of the mirror, the student is recommended to examine a diatom of moderate difficulty, such as *Pleurosigma angulatum*, with a good $\frac{1}{4}$ or $\frac{1}{5}$ objective, which should be accurately adjusted for the thickness of the cover glass, and a deep eye-piece should be used. It will be found, when the light is central, that none of the usual markings will be visible; but when the illuminating pencil falls very obliquely, the *apparent* cross lines (?) will come into view. With the better class of microscopes, the mirror is usually made double, one side concave and the other plane; the plane mirror is used for reflecting daylight when the greatest intensity is not required, and for use with the achromatic condenser and parabolic reflector (Wenham's), and in all other cases when parallel rays are needed. The concave mirror acts in some degree as a condenser, and is to be used with lamp light and when it is required to make daylight more intense. The *diaphragm plate* is used in combination with the mirror to regulate the angle of the pencil; this can, however, be done with much greater nicety by employing the graduating diaphragm of Mr. Collins (Fig. 26) or the very beautiful iris diaphragm of Messrs. Beck (Fig. 27), both of which allow the aperture under the stage to be gradually diminished or enlarged without the interval of darkness which occurs during the shifting of the ordinary wheel of diaphragms.

Fig. 26.

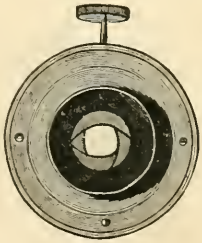
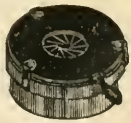


Fig. 27.



* The substance of a course of lectures delivered to the members of the Quekett Microscopical Club, January—April, 1869.

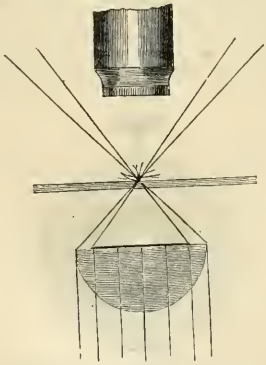
[English Edition, Vol. XX., No. 523, page 265.]

A very useful illumination, resembling the light of a *white cloud*, may be obtained by placing a piece of white paper over the mirror, and concentrating the light of a lamp upon it by means of the condensing lens. The soft white light so produced is extremely pleasant to use, and suits delicate and transparent objects viewed with the binocular, and will be found of more general service than the full light of the mirror, which, with the double body, often produces a most disagreeable glare, which only obscures and confuses instead of defining.

The mirror affords the simplest means of obtaining what is known as *dark field illumination*, for which we are indebted to the Rev. J. B. Reade, F.R.S., President of the Royal Microscopical Society. His original contrivance consisted of an ordinary condensing lens, so placed with respect to the lamp and the stage, that it transmitted a pencil of such obliquity that none of it entered the object-glass, so that the object alone was lighted, while the field remained dark. The same effect can be produced with the mirror when turned very much aside, and only a low power, such as an inch or $\frac{2}{3}$ objective, is employed. It is a most valuable mode of illumination, and one which the author employs very extensively, as independently of the beautiful effects produced by it when skilfully managed, it enables structural peculiarities to be observed which are not readily demonstrated by other means.

The black field is still more perfectly obtained by the use of the *spotted lens* (Fig. 28). This consists

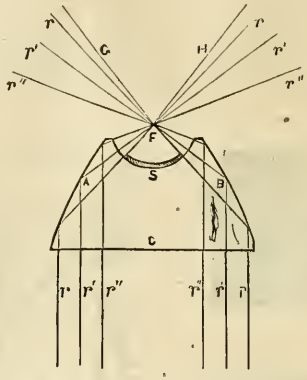
Fig. 28.



of a small bull's-eye, mounted so that it will slide up and down in a fitting beneath the stage to allow of focussing; on the centre of the plane side of the lens is placed an opaque black stop, allowing only the marginal rays to pass. If an object is placed in the focus of the hollow cone of light so transmitted, it will be found, if possessing sufficient opacity, to disperse a portion of the light, to shine brilliantly, and become apparently self-luminous, while, as will be seen by the diagram, the rays, after crossing at the focus, diverge, and do not enter the object-glass, and so leave the field more or less black. The effect is very much that of causing a semitransparent object to appear like an opaque one illuminated by reflected light. *Diatomaceæ*, living aquatic animals and plants, the skeletons of the *Polyzoa*, insect preparations, when not too thin and transparent, and many other objects, are displayed to the greatest advantage by means of black field illumination.

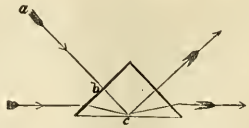
Black field illumination is obtained most perfectly by means of a *paraboloid* placed beneath the stage. Mr. Wenham's first contrivance consisted of a silvered parabolic cup, open at the apex, which reflected parallel rays very obliquely, the access of direct light being prevented by a stop placed in a proper position. The performance of this illuminator was perfect, the only objection to it being that it was rather difficult to keep the reflecting surface bright. This has been remedied by constructing the paraboloid of glass, the illuminator now in use being a solid cast in glass of the original silvered speculum (Fig. 29). It reflects

Fig. 29.



light quite as well as if it were silvered, owing to the law of internal reflection. When a ray of light passing through glass falls upon the surface the angle of which is not less than 38° 41′, it cannot pass out of the glass into air, but is totally reflected (Fig. 30).

Fig. 30.



The ray, *a*, entering the triangular prism at *b*, passes through to *c*, where not being able to pass out into air, it is reflected, as if the surface at *c* were silvered, only far more perfectly, the reflection being total. This principle is made extensive use of in the construction of optical apparatus, a reflecting prism being always preferable when it can be used, on account of its wasting less light than a metallic speculum or silvered glass mirror. If a tumbler is filled with water, and the surface of the water looked at upwards through the side of the glass, it will be

found that the surface of the water will reflect light more brilliantly than the best mirror. The glass paraboloid, although unsilvered, and appearing at first sight to be a lens rather than a mirror, is nevertheless a far more perfect reflector than its metallic predecessor. Parallel rays (Fig. 29, *r*, *r'*, *r''*), falling upon the plane surface, c, at right angles, enter the glass paraboloid without refraction, and not being able to pass out through its curved sides, A, B, are reflected to the focus, F, and diverge from thence at an angle so great that none of them enter the object-glass. The apex is ground out to a spherical figure, so that the pencil also emerges without refraction. The centre stop, S, is attached to a wire passing through a hole drilled in the block of glass, and furnishes a means of adjustment, so that the least oblique rays can be cut off if required, which is necessary when the paraboloid is used with the higher powers, the stop in that case being pushed up as far as it will go. A well constructed paraboloid is capable of giving a black field with a $\frac{1}{8}$th of 100° of aperture. The paraboloid is superior to the spotted lens on account of its freedom from chromatic and spherical aberration, and also from its larger angle, which is about 127°, while the angle of the spotted lens is a little under 90°. The spotted lens, however, can be used with advantage in examining objects which have a degree of transparency which would prevent their perfect observation with the paraboloid, this latter illuminator being better suited for the examination of semi-opaque or translucent tissues. Black field illumination, like that by reflected light, is perhaps more free from the deceptive appearances which so frequently lead to errors of interpretation, and one or both of these modes of lighting should always be employed when practicable. As the amount of light stopped by the object depends in some degree upon its opacity, the relative density of the various parts may be fairly judged of by their respective brilliancy. Dark field illuminators aid very much in the production of stereoscopic effect, no methods of illumination, saving those by reflected light, giving such correct views of the relative position in depth of the various parts of an object, with an advantage peculiar to themselves of revealing internal structure to a great extent.

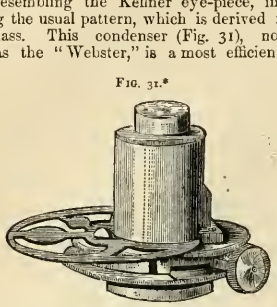
In the old microscopes, constructed before the introduction of the achromatic principle, the want of light was very evident when any but the lowest powers were used; this soon led to the employment of some means of increasing the intensity of the illumination. The usual plan was to place a lens beneath the stage, which acted like a burning-glass, and allowed the light to be increased to almost any extent. When the microscopic object-glass was freed from the chromatic and spherical aberrations, the increase of illumination following the enlargement of its angle of aperture for a time satisfied observers; soon, however, a larger amount of light was, in some cases, found desirable, and it was usual to employ one of the object-glasses (generally the next lowest to the one in use) to concentrate the light upon the object. This simple contrivance is very effective when nothing else but greater intensity is needed, and a foreign $\frac{1}{4}$ object-glass will make a very good combination for this purpose when suitably mounted. For the next improvement, we are indebted to Mr. Gillett, who added a series of diaphragms; these, in the most improved form, comprised some having marginal as well as central apertures, as it was soon found that the direction of the light had a very important influence. The condenser has since undergone many improvements, each of the three leading opticians modifying it to suit the requirements of their respective instruments. It consists, as now made, essentially of a combination of achromatic lenses closely resembling an object-glass, and fitted with one or more diaphragm plates, which, either separately or in combination, give perfect control over the amount of light admitted and its direction; the details of construction vary somewhat in different condensers. This is mounted beneath the stage of the microscope with suitable adjustments for focussing, and also for placing it truly in the axis of the instrument, or centering. As the instrument is difficult for the beginner to use, it is well to give a few directions.

The first care will be to centre the condenser, as the spot of condensed light is extremely small, and should the adjustment not be accurately made, the field of the microscope will be only partially, or not at all, illuminated. The simplest way of centering is to screw on a very low power, and view the setting of the top lens of the condenser; it will then be readily seen whether it occupies the centre of the field, and, should it not do so, the requisite traversing screws are moved until it is found to be accurately in the centre. Or the image of a lamp-flame may be formed with the condenser, and viewed with a moderately-low power, and the screws moved until the image occupies the centre of the field. The focus is then to be adjusted by moving the milled head connected with the proper rack, and a suitable diaphragm turned into place. When the achromatic condenser is used, the flat mirror is to be employed, and if a lamp is the source of light, the rays must be rendered parallel, as before mentioned. Some observers use a prism in the place of a mirror, as it reflects more light, and of a purer quality, than a silvered glass, which gives a reflection from its upper as well as its silvered lower surface, which is likely somewhat to interfere with the perfect illumination of delicate objects. Although the most intense light is obtained when the condenser is accurately in focus, it is sometimes preferable to use the condenser somewhat out of focus; for this, as well as the choice of diaphragms, no particular directions can be given, as much depends upon the nature of the object to be viewed, construction of the instrument, and many other circumstances. A little practice, with the help, if attainable, of an experienced microscopist, will be found the best means of mastering the use of this rather difficult instrument. It is an instructive exercise to place a suitable object upon the stage—a Diatom, for instance—and notice the changes in appearance produced by altering the focus of the condenser and using different diaphragms; so varied are the kinds of marking produced on some of the *Diatomaceæ* by changes of illumination, that it would hardly be believed that the object was the same. It is now tolerably certain that the striæ, or lines, whether single or crossed, and the dots seen on some of these objects, are non-existent, being merely the optical rendering of closely-packed transparent hemispheres. These were observed some years ago by Mr. Wenham, with a 1-50th objective of his own construction, and quite recently by a new and comparatively simple means of illumination discovered by the Rev. J. B. Reade, and described by him in the *Monthly Microscopical Journal* (1869, vol. ii., p. 5). The instrument used is an equilateral triangular prism, which is so adjusted as to reflect an oblique beam of parallel rays. With this illumination, the hemispheres on *Pleurosigma formosum* may be seen with a power so low as a $\frac{2}{3}$, provided the angle of aper-

ture be sufficient. This simple illuminator may probably be of great value for other purposes, besides viewing the surfaces of *Diatomaceæ*; at present, however, it has been so short a time in use, that its full capabilities have not been tested.

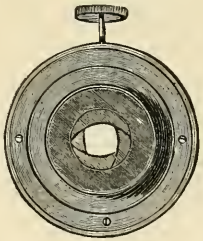
More recently, a condenser, constructed on a different principle, has been introduced, the optical portion closely resembling the Kellner eye-piece, instead of following the usual pattern, which is derived from the object-glass. This condenser (Fig. 31), now well-known as the "Webster," is a most efficient instru-

Fig. 31.*



ment, and, from the simplicity of its construction, is capable of being adapted with advantage to small microscopes. The amount of light given by it is considerable, so great that with the full aperture it is almost more than the eye can bear; this excess of light, if it can be considered as a fault, is certainly a good one, as it permits a very extensive use to be made of diaphragms. The graduating diaphragm (Fig. 32) can be

Fig. 32.*



applied to the Webster condenser with the greatest advantage, and its effect is much more marked than when merely used below the stage to control the illuminating pencil from the mirror. The wheel above the graduating diaphragm consists of a series of central and lateral stops, by the use of which a great variety of oblique and dark field illumination can be obtained; the latter far more efficiently than by the use of the ordinary spotted lens. Recently, a revolving carrier for additional diaphragms has been added to this condenser. It consists of a tube sliding into the lower part of the condenser, and provided at its upper extremity with a contrivance for holding a disc of card or thin brass, in which one or more apertures may be cut. By turning the diaphragm-holder round, the oblique pencil may be directed from any azimuth, and the effect on such objects as the *Diatomaceæ* is very marked indeed, the striæ appearing or disappearing as the aperture is moved to, or away from, the proper angle for bringing them out. This contrivance also allows the observer to try any forms of stop he may consider advantageous, as they may be quickly cut out of a piece of blackened card (B. W. Richardson, *Quarterly Microscopical Journal*, vol. vi., pp. 10, 86). The long focus and large field of the "Webster" render it particularly useful for the general purposes of the student, as it will work into some depth of water, and can be used for illuminating the interior of the troughs so frequently employed in observing living aquatic animals and plants. Although surpassed by the more costly instruments for the most refined description of illumination, it possesses merits peculiarly its own, and no single piece of apparatus can be made to perform so great a variety of offices as this very useful condenser.

The most useful forms of illuminating apparatus have now been described; there are many others, chiefly meant for special purposes—they will be found in the works of Quekett and Carpenter, and the pages of the *Microscopical Quarterly* and *Monthly Journals*, to which the student is referred for descriptions and figures.

In the modes of illumination hitherto described, the light has been made use of in exactly the same condition in which it was received from its source, whether from the sun or a lamp. All that instruments have been required to do has been either to alter its direction or, by concentration, to increase its intensity. It is now proposed to explain a method of conducting microscopical investigations in which the properties of the light have undergone such changes as to produce effects totally different from those of ordinary illumination, and with the result of giving greater insight into the nature of certain structures than could be obtained by other means. The light, in the condition now to be described, is commonly known as *Polarised light.*

With a view to simplify the matter contained in the foregoing papers, no more has been said about the nature and properties of light than was absolutely necessary to enable the action of the apparatus described from time to time to be tolerably well understood. And, although, in the present chapter, far more notice must be taken of the subject, it is by no means intended to give an exhaustive account of the phenomena of polarised light. Space can only be afforded for such an outline as will enable the student to use his apparatus, and observe intelligently. For details, reference must be made to works treating more fully on the subject—such as the chapters on Optics in Mr. Brooke's "Manual of Natural Philosophy," and the various authorities there referred to.

Light, in common with the other forces of nature—heat, electricity in its various forms, dynamic force, &c.,—proceeds from its source in a series of undulations or waves, which may be illustrated in a rough manner by throwing a stone into a pond, when the waves will be seen to spread themselves concentrically from the source of motion.

For convenience of explanation, a ray of light in its ordinary condition may be represented in ideal section by a circle (Fig. 33, 1), and undulations supposed to take place in two planes at right angles to each other (C, D and N, S). By means presently to be described, these two sets of waves can be separated, as at 2, C, D and 3, N, S. The ray of light, instead of having the same properties on every side, will be found to have acquired

* For these woodcuts we are indebted to Mr. Collins, of Great Titchfield Street.

some qualities peculiar to the state in which it now is, and which may be named the properties of sides. For instance, 2 will exhibit certain phenomena in the direction C. D which do not exist when it is examined in other directions. The same is the case with the other half of the ray (3), which exhibits similar phenomena in the direction X, S. As these properties somewhat resembled those of the poles of a magnet, the term *polarised light* was used to distinguish light so modified, and, although perhaps not the best name that could have been given, has still been retained.

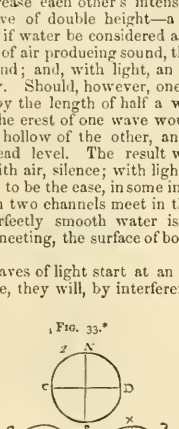
As the phenomena of interference will be frequently mentioned, it will be desirable to state what they are. The sensation affecting the optic nerve which is known as light is caused by the undulations before spoken of—light being represented by motion, darkness by rest.

Should two waves start together from the same place, they would increase each other's intensity; the result would be a wave of double height—a matter easy of comprehension, if water be considered as the medium; with the waves of air producing sound, the result would be a louder sound; and, with light, an illumination of double intensity. Should, however, one wave start before the other by the length of half a wave, the effect would be that the crest of one wave would occupy the position of the hollow of the other, and so fill it up, producing a dead level. The result would be, with water, calm; with air, silence; with light, darkness.

This is known to be the case, in some instances, where the streams from two channels meet in the manner just mentioned: perfectly smooth water is produced, although, before meeting, the surface of both may be violently agitated.

Should the waves of light start at an interval of less than half a wave, they will, by interference, be broken

Fig. 33.*



up into smaller waves, the magnitude of which depends upon the distance one wave has had the start of the other. These small waves produce coloured light, the red wave being the longest, and the violet the shortest. Mr. Woodward gives the following as the lengths of the waves of the various coloured rays of the spectrum:—Red, 266; orange, 240; yellow, 227; green, 211; blue, 196; indigo, 185; violet, 167. The figures represent the numerators of fractions, having as a common denominator the ten-millionth of an inch.

These coloured waves may be produced in various ways; for instance, by very thin plates of transparent substances, such as mica, films of oil or varnish floating on water, and films of air enclosed between transparent solid surfaces, which, by causing a slight difference in the distance of the starting points of the two series of waves of white light reflected from the upper and lower surfaces of the film, sets up interference, and breaks up the waves of white light into smaller coloured ones. The films of varnish were very ingeniously taken up from the surface of water on enamelled cards, by Mr. De la Rue, giving them a beautiful iridescent appearance. Other examples may be found in the feathers of certain birds, as humming birds, peacocks, &c., which possess a metallic lustre produced in the same manner. A minutely grooved surface will also produce similar effects; for example, mother-of-pearl, which consists of a series of thin plates of shell, separated by folds of membrane, producing a grooved structure; also in the finely-ruled gold ornaments known as "Barton's buttons," and the minute specimens of ruling on glass by Nobert, all of which produce brilliant metallic tints by the interference of the two waves reflected, one from the surface, and the other from the bottom of the groove.

If a convex lens of extremely shallow curvature be placed upon a plane glass surface, and an arrangement be provided for exercising delicate and uniform compression, a series of circular concentric coloured bands will be seen; these are known as "Newton's rings," and are caused, as before, by the interference of the reflections from the film of air contained between the lenses; and as, from the curvature of the lens, the film is of a thickness increasing from the centre to the circumference, a variety of tints are formed at every change of thickness, the rings consisting alternately of groups of colour and dark bands, the latter being the places where total interference takes place and darkness or rest is the consequence. These dark spaces are much better seen when the apparatus is viewed by a monochromatic light, such as that produced by the flame of a large spirit-lamp the wick of which has been sprinkled with common table-salt. Not only will the dark bands be sharper and more intense, but they will also be considerably increased in number. These rings may often be seen when plane glass surfaces are unequally compressed; for example, a piece of thin cover-glass pressed on a slide with a stick, and sometimes between the thick plate and glass negative in a photographic printing frame.

The undulatory motion of light would seem to be expressed with considerable clearness in the first chapter of Genesis when read in the original Hebrew, which, in common with the other languages of the same family, is remarkable for the numerous inflexions of its verb, which gives it a delicacy and precision of expression unattainable in Western languages. The first verse concludes:—"And the Spirit of God *moved* upon the face of the waters." This sentence immediately precedes the command that light, which may here be taken in its largest sense, including electricity and the other forces, should exist. The Hebrew word translated "moved" is more accurately expressed by *fluttered;* the same inflexion of the verb is used in this sense in the only other place in which it occurs, viz., Deuteronomy xxxii., 11., where it refers to the fluttering of an eagle over its nest. It is certainly a very remarkable expression, and the author believes that its bearing on the subject of light has hitherto escaped notice. The view that the word "light" includes the other forces, and which we have every reason to believe are but different manifestations of them, is supported by the fact, that sources of light proper or luminaries are not mentioned until the fourteenth verse, while the atmosphere or "firmament" of the English version, land, and water, and vegetable life, were all in existence, and under the influence of these mysterious powers of na-

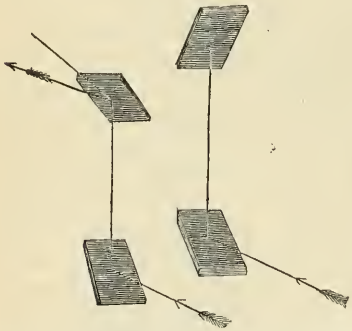
* Brooke's "Natural Philosophy," published by Churchill.

ture, respecting which the undiscovered and unknown probably far exceeds the little that science has at present made us acquainted with.

Light may be polarised in several ways. If a ray of light falls upon glass at an angle of 56° 45', one-half (Fig. 34) will be transmitted, the other half reflected: and, if, instead of a single plate, about ten sheets of thin window-glass be employed, the result will be much more perfect. The reflection, whether one or more plates be used, will be much improved by either coating the back with black-varnish, or placing in contact with it a piece of black cloth or velvet, which will absorb the transmitted portion of the ray. If the light so reflected be examined by another glass mirror, placed at the same angle, and so mounted that it can be moved horizontally in a circular direction, it will be found that, in some positions, the light will be reflected, while, at others, it will pass through, or be absorbed if the back is blackened. These intervals of reflection and transmission occur alternately at every quarter revolution of the upper mirror or analyser, corresponding with the points in Fig. 33, I, marked C, D and N, S.

If a ray of light be passed through a crystal of Iceland spar, one portion will be refracted according to the

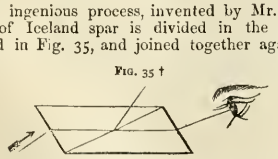
Fig. 34.



usual law; * the other half will be refracted in a different direction. And, if these two rays of light be examined with an analyser, they will be found, as in the case of the reflected light, to have acquired the property of sides, or to be polarised. The ray refracted in the common way is known as the ordinary ray. The other, which is polarised in a plane at right angles to it, is termed the extraordinary ray. If a crystal of Iceland spar be placed on a sheet of paper having a black spot on it, the double refraction will cause the formation of two images of the spot or other device drawn on the paper.

By an ingenious process, invented by Mr. Nicol, a crystal of Iceland spar is divided in the direction indicated in Fig. 35, and joined together again with

Fig. 35 †

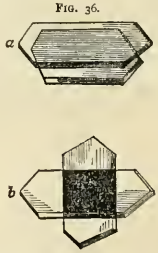


Canada balsam. This causes one of the rays to be so much refracted that it is thrown altogether out of view, and only one polarised ray is transmitted. This contrivance is known as the *single image* or *Nicol prism*, and is the means of polarisation most generally adopted for microscopical purposes.

Polarisation may also be effected by the use of thin slices of a mineral known as *tourmaline*. This crystal, when cut into thin plates parallel to the axis of the crystal, allows only the undulations in one plane to pass, the other being stopped. The cause of this action is, as yet, not understood. If two plates of tourmaline are superposed, and held before a strong light, it will be found that the light is alternately transmitted and stopped at every 90°, when one of the plates is rotated.

The same effect is produced, in a much greater degree, by using a pair of crystals of sulphate of iodoquinine, more commonly known as *Herapathite*, from its discoverer, the late Dr. William Bird Herapath. This salt is prepared by a tedious and complicated process, and described in a communication by Dr. Herapath to the Royal Society, and quoted in many microscopical works ("Micrographic Dictionary," second edition, p. 590). The obtaining of large regular crystals fit for polariscopes is a matter of great difficulty; and, unless the student is very expert in chemical manipulation, he is recommended not to attempt it. Small specimens fit for

Fig. 36.



microscopical examination may, however, easily be made. This salt is the most powerful polarising agent known. If two crystals are superposed with their axes parallel (Fig. 36. *a*), light is readily transmitted; but, if the axes are crossed, as in *b*, the parts covering each other become perfectly opaque to transmitted light. This can easily be seen in a slide of the crystals mounted as a microscopical object, as some of the crystals are sure to be in this position.

The sky possesses the power of reflecting polarised light. If the observer stands with one shoulder directed to the sun, so that he faces a point 90° from it, and looks at a white cloud through a Nicol prism, he will find that the light reflected from the cloud is polarised, and that, as the prism is rotated, the cloud will alternately appear as a white cloud on a dark ground and a dark cloud on a light ground.

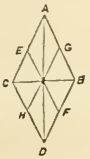
The effects here described may readily be seen without the special apparatus of mirrors, &c., by any one who has a microscope fitted with the usual polarising apparatus of two Nicol prisms. If the larger one, *the polariser*, be put in its place below the stage, and the mirror so arranged that the light

* Chemical News, vol. xx., p. 145; *Am. Repr., Nov.*, 1869, *page* 281.
† Pereira on "Polarised Light," published by Longmans and Co.

of a lamp or daylight be directed through it, it will be found, upon rotating the prism in its fitting, that no change is apparent, as the light, although polarised, is transmitted in every position of the prism. If the small prism, or *analyser*, be now put in its place, either over the object-glass or, better still, over the eye-piece, it will be found that the alternate transmissions and stoppages of light take place. If a film of *selenite* be now placed on the stage of the instrument, it will be found that the light will be coloured; and, when one of the prisms is rotated 90°, the colour will change to the complementary tint. For instance a film that transmits red light in one position of the prisms will transmit a green of such quality as to produce white light, were the two mixed. Blue would produce orange every quarter revolution; and so on through the other tints of the spectrum. Similar effects are produced by using films of mica, and all crystals possessing the property of double refraction.

To understand these changes of colour, it will be necessary to describe the direction of the axes of a crystal of selenite, which is represented in Fig. 37,

Fig. 37.*



A, D and C, B being the position of the depolarising axes, and E, F and C, H that of the optic axes. To understand the powers of these regions of the crystal, it will be necessary to try another experiment, which, although more advantageously shown with a large polariscope, can be done sufficiently well under the microscope. Let the film of selenite be so mounted as to be capable of rotation. If the stage of the microscope is capable of concentric rotation, no further contrivance is necessary. If the prisms now be arranged for the production of colour, and the selenite be slowly rotated, it will be observed that the colour gradually disappears. On continuing the rotation, it increases, and regains its intensity. If the amount of rotation is noticed, it will be found that the disappearances coincide with the position of the optic axes, E, F and G, H, and while the greatest intensity of colour is produced when the plane of polarisation passes through the depolarising axes, A, D and B, C. If the analyser be removed, no colours are to be seen; it is therefore evident that the analyser plays some important part in the production of these colours.

The selenite, being a doubly-refracting crystal, causes the ray of polarised light to be divided into two, which are, as usual, polarised in perpendicular planes, and, reaching the eye together, no colour is produced; but, if the analyser is added to the combination, the colourless image is broken up into two coloured ones, one only of which reaches the eye. If, instead of the Nicol prism, a contrivance known as the "double-image prism" be used, which will transmit both rays, but in a separate condition, the two images of complementary colours will be seen at once, and if, by a suitable contrivance, they be made partially to overlap, the part where they join will be white, produced by the union of the two complementary tints.

The position of the optic axes may be easily observed in the corpuscles of starch and other polariscope objects which produce the well-known black cross, which indicates in a very marked manner the situation of these axes of no polarisation.

The apparatus employed for the examination of microscopical objects by means of polarised light consists of a *polariser*, *analyser*, and *retarding plate*.

The *polariser* is generally a Nicol prism, mounted so that it may be conveniently rotated; this is attached, by a suitable fitting, either beneath the stage, or, in large microscopes, to the sub-stage movement.

The *analyser* varies, being, according to circumstances, a Nicol prism, tourmaline, or Herapathite. The *Nicol prism* is the form of analyser generally used, and can be placed either over the eye-piece or within the body of the microscope above the object-glass; in the first position it has the advantages of being easily rotated, and of not interfering seriously with the definition of the magnified image; but, on the other hand, when used with any eye-pieces but those of the lowest power, it cuts off the margin of the field and reduces it to an injurious extent; this is owing to the prism by its thickness causing the removal of the eye to some distance from the eye-glass, although the Nicol prism, when intended for use as an analyser, is generally made as short as is consistent with efficient action. When the prism is placed within the body, it does not cut off any portion of the field, but the interposition of a dense substance, like Iceland spar, impairs the corrections and consequently the definition of the object-glass, and also causes some loss of light. It is much to be regretted that in many of the smaller microscopes no other provision is made for the placing of the analysing prism. When the binocular is used with polarised light, the analyser can be placed in no other position, and it is usually mounted in a short adapter so contrived that the prism can be easily rotated. It is well to have the means of using the analyser in both positions, that choice can be made of that best adapted to the kind of observation in progress; if very perfect definition is of less consequence than a field of full dimensions, as in viewing such objects as crystals, in which very little detail is to be seen, then the prism in the body may be employed with advantage; but should the formation of an image very perfect in its details be required, then the prism must be placed over the eye-piece.

Tourmaline, when it can be obtained of sufficiently pale colour, makes a good analyser; from its thinness it can be used over deep eye-pieces without cutting off the field; good stones are, however, scarce, and consequently expensive, as many light coloured specimens do not polarise well. The tourmaline is mounted in a brass cap similar to the one placed on the eye-piece, which is to be removed and the analyser substituted. Crystals of *Herapathite* polarise more powerfully, and are much lighter in colour than the palest specimens of tourmaline, and when they can be procured make very perfect analysers; they are extremely thin and do not interfere at all with definition, and are to be preferred in all delicate investigations. Where, however, total

* Brooke's "Natural Philosophy," published by Churchill.

freedom from colour is a necessity, the Nicol prism, notwithstanding its other disadvantages, must be used.

The *retarding plate* or *selenite film* is commonly mounted, either on card, like an ordinary slide, or else in a brass plate, with a ledge to keep the object from slipping off; this is a very disadvantageous form, as the selenite cannot be rotated, while in a perfect polarising arrangement, every part, object included, should be capable of rotation. The most convenient and useful arrangement of selenites is that devised by the late Mr. Darker, in which a series of three discs are by combination made to give as many as thirteen different tints. In large miscroscopes having a substage, these selenites can be mounted so as to be capable of rotation either together or separately, and also allowing the selenites to be used or not, without disturbing the arrangement of the object on the stage.* These advantages have hitherto been confined to large miscroscopes; but Mr. Baily has so mounted a set of Darker's selenites for the author that they can be placed upon the stage in the ordinary manner, and at the same time allow of discs being added or withdrawn and rotated, without interfering with the object; the thickness of this stage plate is no more than is necessary to contain the three discs and allow them space to move, and all complicated machinery is dispensed with. The arrangement of Darker's system of selenites appears, at first sight, somewhat complicated, but is not so in reality, and the power of obtaining such a variety of coloured backgrounds is a very great advantage. The series consists of three discs, marked $\frac{1}{4}$, $\frac{2}{4}$ and $\frac{3}{4}$, which figures represent a certain amount of retarding influence upon the wave of polarised light and consequent colour production. Besides the figures just mentioned, each disc has engraved upon its mounting the mark P.A., meaning positive axis; when the selenites are superposed with these marks coincident, the effect is, that the power of one selenite is added to that of the other; for example, if the $\frac{1}{4}$ and $\frac{2}{4}$ discs are so placed, the power will correspond to the sum of the numbers, viz., $\frac{3}{4}$, but if the $\frac{1}{4}$ be turned round 90° then the $\frac{2}{4}$ will have only a power of $\frac{2}{4}$, the crossed position of the $\frac{1}{4}$ subtracting instead of adding its power to the $\frac{2}{4}$. The experiments with selenite films already described will have prepared the student to understand the cause of this; it will be recollected that the colour disappeared when the selenite passed through one of the optic axes of the selenite, provided the position of the prisms remained the same. If, instead of moving the disc 90° it be only moved 45°, the effect will be to neutralise; instead of giving a negative power the result will be the same as if the selenite were withdrawn. The following table, of the arrangement of Darker's selenites may be useful to those who possess the series. The colours vary somewhat in different sets, so the table must be made out by each observer for his own use. The colours in the following table are those given by Richard Beck in his work on "The Microscope:"—

	Prisms at right angles.	Complementary tint.
1. $\frac{1}{4}$ by itself.....	Very light lavender.	Straw colour.
2. $\frac{2}{4} - \frac{1}{4}$.....	Darker do.	Light yellow.
3. $\frac{2}{4}$ by itself.....	Deep blue.	Light maize.
4. $\frac{2}{4} + \frac{1}{4}$.....	Very light blue.	Orange.
5. $\frac{3}{4} - \frac{2}{4} - \frac{1}{4}$....	Lake.	Emerald green.
6. $\frac{3}{4} - \frac{2}{4}$.....	Deep blue.	Bright yellow.
7. $\frac{3}{4} + \frac{2}{4} + \frac{1}{4}$...	Light green.	Light purple.
8. $\frac{3}{4} - \frac{1}{4}$.....	Light plum colour.	Pea green.
9. $\frac{3}{4}$ by itself.....	Blue green.	[Salmon.
10. $\frac{3}{4} + \frac{1}{4}$.....	Green yellow.	Mauve.
11. $+ \frac{2}{4} - \frac{1}{4}$...	Pink light.	Green.
12. $\frac{3}{4} + \frac{2}{4}$.....	Light pink.	Deep green.
13. $\frac{3}{4} + \frac{2}{4} + \frac{1}{4}$ ...	Very light red.	Stone green.

(To be continued.)

* A very perfect polarising apparatus is described by Mr. J. J. Field, *Journal of the Quekett Microscopical Club*, vol., p. 215; also in *Monthly Microscopical Journal*, vol. ii., p. 276.

ON THE

CONSTITUTION OF SODIC SULPHATE IN SOLUTION.

BY CHARLES TOMLINSON, F.R.S.

I. Modern Hypotheses.

In the Chemical News (vol. xx. p. 241; *Am. Rep.*, Jan. '70, page 19), you quote, from the *Comptes Rendus* of April 19th, 1869, a note by M. Dubrunfaut, in which he gives credit to M. Löwel for having demonstrated and put in evidence this capital fact—that sodic sulphate, dissolved in water as

$$NaO,SO_3 + 10HO.$$

is found in solution as $NaO,SO_3 + 7HO$. The salt has undergone a molecular change. "We imagine we have dissolved the 10-atom salt; but, in surcharging the solution with an excess of it, we have so modified its composition as to create a new and more soluble compound, capable of producing the strange and mysterious phenomena of supersaturation."

The molecular change which is so clearly made out to this observer is by no means so clear to M. Lecoq de Boisbaudran. In a note to the *Comptes Rendus* of May 3rd, he expresses his opinion that sodic sulphate, in the aqueous solution, is no longer constituted with 7 equivalents of water, any more than with 10, or without any water at all; "but that it may exist under all conditions of hydration, known or unknown, of which the existence is possible. The co-existence of many hydrates in solution is not more difficult of comprehension than the phenomena of dissociation or the equilibrium of ethereal reactions."

In a note in the *Comptes Rendus* for May 10th, M. F. Margueritte denies the justice of M. Dubrunfaut's position as regards the molecular change imputed to alcoholic supersaturated solutions of sugar. He treats the theory as a simple allegation:—"We have hitherto supposed a supersaturated solution to be one in which a liquor dissolves a substance in a proportion which exceeds its normal solubility. The alcoholic solutions of sugar are in this condition; they present the characters of supersaturation, properly so called; and we do not understand the argument of M. Dubrunfaut in opposition to this established fact. . . . As a point of departure, he supposes salts or bodies that present the phenomena of supersaturation to undergo, in dissolving, a modification which augments their solubility; as, when the 10-atom sodic sulphate solution deposits the 7-atom salt, he supposes this to have pre-existed in the solution. In following up this reasoning, we may suppose the salt to exist in three states in the solution, viz., the anhydrous, the 7-atom, and the 10-atom varieties, since we can obtain, at different temperatures, all three. These are simple hypotheses, which cannot resolve the delicate question as to the condition of salts in solution."

On May 24th, a second note appeared from the pen of M. Dubrunfaut. Taking sodic sulphate as the typi-

cal salt for the phenomena of supersaturation, he admits that it offers exceptions to the general laws which regulate solubility as a function of the temperature. The investigation is difficult, because the state of supersaturation can be maintained only in close vessels, so that, in seeking to apply physical tests, crystallisation sets in, and the state of supersaturation is at an end. Moreover, these solutions are not obedient to the test of optical rotation. Hence, in interpreting Löwel's hypothesis, M. Lecoq de Boisbaudran has not a more solid standpoint than M. Dubrunfaut. But there can be no doubt that sodic sulphate, in the condition of supersaturation, has lost its primary constitution as a 10-atom salt, since its solubility has increased tenfold at 0° C. It owes this modification to the influence of the water, though heat may regulate the exertion of it.

Now, the 10-atom salt, at 18° C., gives at once, to water, a density of 1120, water being 1000. This is the density of the normal saturated solution.

The mother liquor of a solution saturated at 103°, which, after being supersaturated, is made to deposit the normal salt by disturbing the state of supersaturation, has also a density of about 1120 at 18°. The mother liquor of the crystals formed after saturation at 33° has a similar density.

If the anhydrous salt formed by drying the 10-atom salt be treated with water at 18°, the initial density of the solution is 1157, which, after five or six hours' contact with excess of the salt, rises to 1167. It then falls, and after twenty-four hours, it becomes 1120 at 18°.

The anhydrous salt vitrified by fusion appears to be a little more soluble under the same conditions, since the initial density of the solution, which is 1167, attains the maximum of 1180, but, in twenty-four hours, falls to 1120.

The 7-atom salt cannot, of course, be operated on; but it is known to be less soluble than the anhydrous, and the density of its mother-liquor is 1120.

Hence there is only one fixed term of solubility, namely, that given by the 10-atom salt, and represented by 1120 at 18° C. Whatever modifications are produced in the solutions by means of temperature or supersaturation, the mother liquor always returns, after the lapse of sufficient time, to this normal, fixed density of 1120.

In considering the abnormal solubility of the anhydrous salt, whether obtained by drying or fusing the 10-atom variety, and in comparing the amorphous state of this salt with sugars in the state of supersaturation, are we not led to conclude that the molecular constitution of the anhydrous sulphate has the same constitution as that of the sugars in supersaturated solutions?

The depression in temperature which accompanies solution implies a transfer of heat into molecular mechanical work under the conditions of supersaturation. When this state ceases, the temperature rises, implying an inverse transfer of mechanical work into heat, in consequence of the return of the saline molecule to its primary constitution.

The facts of superfusion and supersaturation are well explained by changes in physical and chemical constitution brought about by fusion or solution, the two molecular conditions being, probably, the crystalline and the amorphous.

Such are M. Dubrunfaut's views, which I have endeavoured to give in a condensed form. M. Margueritte replied, on June 7th, that M. Dubrunfaut's hypotheses are contradicted by experiment. Crystallised sugar may form supersaturated solutions in dilute alcohol, and still preserve intact its optical properties, and, therefore, the identity of its constitution, a fact which proves that the increased transitory solubility of a body is not the effect of a molecular change or of an isomeric modification.

The same number of the *Comptes Rendus* contains also a note by M. Lecoq de Boisbaudran, in reply to M. Dubrunfaut. After some remarks on change of structure by means of fusion, which produces modifications similar to those which result from solution, he admits that Löwel's hypothesis rests on facts observed under conditions when supersaturation no longer exists. While not agreeing with M. Dubrunfaut, he does not insist on his own hypothesis; and, although optical tests fail in the case of sodic sulphate, yet an experiment with chrome alum shows the co-existence of two different modifications in a definite state of solution. Dissolve chrome alum in the cold, and the solution has a blue-violet colour; dissolve the same salt in boiling water, and the solution is dark green. If the two solutions be exposed to the ordinary temperature, the blue solution soon loses a little of its purity, and tends to become greenish, while the green solution tends to become bluish, until at length the two solutions pass into the same green-blue colour, which represents the intermediate state between the initial modifications.

M. Lecoq de Boisbaudran cannot understand M. Dubrunfaut's object in undertaking new experiments on the density of the mother liquors of sodic sulphate, since it has long been known that, by exposure to the air, the 10-atom salt is produced from the various solutions, and that, under like conditions of temperature and saturation, the densities must be equal. If M. Dubrunfaut had operated on the anhydrous salt without exposure to the dust of the air, he would have obtained a stronger mother liquor. When a supersaturated solution resting on an excess of the anhydrous salt is suddenly solidified by contact with a crystal of the 10-atom salt, the mother liquor of the anhydrous salt is much richer than the mother liquor of the 10-atom crystals. He believes the solubilities of all three varieties of the same salt to be equally normal. The solubility of a body ought to be definite under determined physical conditions (temperature, pressure, &c.); but, if such body is in the presence of one of its more stable modifications, this will destroy the initial modification, and we should certainly fall into error in attributing to the primitive body the observed solubility.

M. Dubrunfaut, abandoning the hypothesis which supposes the 10-atom sodic sulphate to exist as the 7-atom in solution, now supposes the anhydrous salt to be in solution. The objections to the opinion that only the 7-atom salt is in solution apply with even more force to the new proposal to make the anhydrous salt play the same part.

Such is the state of the question at the present time among the French chemists whose views are reported by the Academy. The favourite view of supersaturation, both in French as well as English, American, and, I may add, German text-books, is Löwel's—namely, that a solution (say of sodic sulphate) saturated at a high temperature, and left to cool in a close or loosely covered vessel, does not actually become supersaturated, but undergoes a molecular change, in which the 10-atom salt becomes the more soluble 7-atom; so that, instead of having a supersaturated solution of the 10-atom salt, we have only a saturated solution of the 7-atom. When, however, under the influence of some mysterious catalytic action, crystallisation is about to set in, the solution suddenly recovers the

[English Edition, Vol. XX., No. 523, pages 267, 268.]

molecular constitution of the 10-atom salt, as well as its solubility, and the 10-atom salt is thrown down.

All this is very ingenious. The most remarkable circumstance connected with the Löwel hypothesis is that Löwel was himself the first chemist who called it in question. The facts are these:—Löwel's first memoir appeared in 1850; his fifth in 1855; in all of which he maintains the molecular theory above stated in the case of sodic sulphate, and a similar theory with respect to two other salts—viz., the sodic carbonate and the magnesia sulphate. But, in 1857, he published a sixth memoir, in which he strongly inclines to the opinion that, within the limits of a considerable range of temperature, sodic sulphate in solution is in the anhydrous condition. His views will be given in another article.

II.—Löwel's Hypothesis—Another Hypothesis.

As there is no harder or pleasanter intellectual work than original research, so there is no harder or more unpleasant moral work than having to modify or reconstruct one's own theory after having spent years of toil in establishing it, and even after it has been accepted with applause by competent critics. This is what M. Löwel has done; and I cannot sufficiently honour and respect him for his candour in having been the first to awake to the sense of his own defects, and to wind up his work by saying so.

As already stated, his first five memoirs were published between 1850 and 1855. In his sixth and last memoir, published in 1857, he is led, chiefly by three considerations, to suppose that, between the boiling point of a saturated solution of sodic sulphate (103·17° C.) and the point when the 7-atom salt begins to be deposited (18°), it is not this modified salt, but the anhydrous variety, that is held in solution. His reasons are the following:—

1. That the 10-atom salt parts so readily with its water of crystallisation by mere exposure to the air at temperatures between 15° and 20° C.

2. That Faraday found, on evaporating a solution of the 10-atom salt below 100° C. (or, according to Mitscherlich, below 40°), the anhydrous salt was deposited.

3. That, in boiling for some time a saturated solution of the 10-atom salt, small, hard, granular crystals of the anhydrous salt are formed as the solution becomes concentrated.

But M. Löwel cannot get rid altogether of his molecular theory. Although he admits that, between the boiling point of a saturated solution (103·17° C.) and the point when the modified salt begins to be formed (18°), the anhydrous salt is held in solution, yet, at and below 18°, a molecular change comes over the solution, by virtue of which it holds or begins to deposit the 7-atom salt.

In weaker solutions, it is admitted that this molecular change takes place at yet lower temperatures. A boiling solution of 2 parts of the 10-atom salt to 1 part of water, for example, must be cooled to 7° or 8° C. before it deposits the modified salt; while a solution of 1 part salt to 1 part of water must be reduced to 0° before the 7-atom salt is deposited. Hence the 7-atom salt is not deposited at the same temperature, but at very different temperatures, low in proportion as there are fewer saline molecules in solution. He admits that it was an error to suppose the 7-atom salt to be already formed, since such solutions do not begin to deposit the modified salt as soon as the temperature passes below the point at which the solutions would be saturated with that salt if it were really present. Thus the boiling saturated solution would be saturated with the 7-atom salt at about 26° C., and it did not begin to deposit that salt under 17° or 18°. The weaker solution (2 salt to 1 water) would, in like manner, be saturated at 18°; but it was reduced to 8° before the 7-atom salt appeared; while the still weaker solution (1 salt to 1 water) required a reduction of temperature equal to 0°. The first solution evidently contained anhydrous salt up to the very moment when it began to deposit the 7-atom salt; and there is no reason to suppose the other two solutions, although much less rich in salt, to have been differently constituted. Moreover, when the second solution has deposited the 7-atom salt at 7° or 8°, so long as it remains in contact with these crystals, it possesses fixed points or terms of saturation, limited by the temperature—that is, it deposits the 7-atom salt when its temperature is reduced, and it re-dissolves it to saturation when the temperature rises; but, if this elevation of temperature reach to 22° or 24°, so that the 7-atom salt is totally dissolved, the solution will not deposit crystals when the temperature again falls a little below 18°, but it must be lowered to 8° or 7°, just as if it had not deposited salt at all. "Hence," he says, "I conclude that the 10-atom salt, as well as the 7-atom salt, in passing into solution, at whatever temperature, gives up the whole of its water of crystallization. Under what conditions, then, are these salts in solution? I can only give hypotheses; and, without seeking to define this condition, it may be best to say that, in passing into solution, they assume an indeterminate molecular constitution, which may be termed the molecular constitution of sulphate of soda in solution, which differs from the molecular constitution of the crystals of the 10-atom, the 7-atom, and the anhydrous salt."

Löwel has given very full tables of the solubility of each of the three forms of sodic sulphate at various temperatures, and his determinations extend to two places of decimals. "I could not," he says, "determine the point of maximum solubility of the anhydrous salt at temperatures below which it begins to deposit the 7-atom salt. At 18°, the change of state is made suddenly; the solutions become troubled, and deposit crystals of the 7-atom salt in a pulverulent form."

Here I venture to think M. Löwel missed his opportunity. If, instead of depositing "crystals of the 7-atom salt," he could have written, "the anhydrous salt," he would have saved himself from much embarrassment, and the present discussion would have been unnecessary.

It was in repeating some of M. Löwel's experiments during the cold weather of December, 1867, that I observed the sudden troubling of the solution. A stream of nearly ice-cold water was allowed to run upon a flask containing a warm supersaturated solution of sodic sulphate, when it suddenly became opaque, from the formation of a multitude of minute crystals, which seemed to increase in number on gently shaking the flask. On repeating the experiment with more care with solutions in test-tubes placed in transparent freezing mixtures, these crystals were soon recognised as the octohedra of the anhydrous salt. I will quote from my note-book a few out of many of the experiments that were made to determine what seemed to me to be a very important point; for it was this experiment that first led me to question the integrity of the molecular theory, as well as the reality of the so-called catalytic action of the sides of the flasks and of solid nuclei.

A solution of 3 parts of the 10-atom salt to 1 part of distilled water was boiled at 218° F., when a small portion of anhydrous salt was thrown down. The solu-

tion was filtered into a flask, in which it was again boiled. The flask was then plugged, with a thermometer passing through the plug. When the solution had cooled down to the temperature of the room, the flask was put into cold water. At 54°, a few well-shaped, sharply-cut octohedra began to fall. At 50°, the number of crystals had so greatly increased as to render the solution opaque; heat currents were liberated, and the temperature rose to 58°.

Two parts of the 10-atom salt to 1 part water: octohedral crystals began to form at 48°.

One part salt to 1 of water: at 35°, a few well-shaped octohedral crystals were thrown down.

So far, then, it seemed to me to be perfectly well made out that the 10-atom salt, in passing into solution, gives up the whole of its water of crystallisation to the solvent. In heating the solutions, a dendritic crystallisation of the anhydrous salt creeps up the side of the flask just above the level of the solution; and, in filtering strong solutions, a thin anhydrous crust forms on the surface of the liquid in the filter. The proofs are manifold that the anhydrous salt is in solution; but the most convincing proof of the fact seems to me to be the throwing down of anhydrous crystals on lowering the temperature of the solutions to a sufficient degree.

The abrupt change that takes place in the curve of solubility of the 10-atom salt at 33° or 34° C. was pointed out by Gay Lussac, and explained by him that, whereas it is the saline molecule $NaO,SO_3 + 10Aq.$ that enters into solution, yet, beyond this point, when the solubility diminishes up to boiling, it is the anhydrous salt that is in solution.

Löwel remarks on this:—"We can easily explain why the solubility of sulphate of soda presents this curious anomaly of increasing with the temperature up to a certain maximum, and then diminishing as the temperature rises. So long as the salt is in the form of 10-atom crystals, its solubility increases from 0° to 34° C. Above 34° this salt no longer exists; it becomes anhydrous, with a different molecular constitution and solubility. The solubility of the anhydrous salt follows an inverse order as compared with that of the 10-atom hydrate. It diminishes in proportion as the temperature rises, or, what is the same thing, it increases as the temperature falls from 103·17° (the boiling point of a saturated solution), not only to 34°, but also to 18° and 17°, when the dissolved salt undergoes a new modification in its molecular constitution, and begins to form crystals of the 7-atom hydrate."

Now, if it be true that the 10-atom hydrate remains in solution up to 34° C. (93·2 F.), solutions made below that temperature ought to deposit the 10-atom salt on cooling in close vessels, just as they do in open vessels where they are in contact with nuclei; but the fact is, such solutions still deposit the anhydrous salt. Solutions saturated at about 85°, or from that to 88° F., and filtered into flasks warmed to that point, and then plugged, were kept until the next day, without any deposit of salt. On detaining them for some time in a freezing mixture, at from 16° to 25° F., they sometimes froze, but, on several occasions, they threw down small, well-defined crystals of the anhydrous salt. Hence, it cannot be true that, up to 34° C., it is the 10-atom salt that is held in solution.

There remains still one point to be discussed. M. Löwel supposes that the supersaturated solutions, in cooling to 18° or 17° C. (64·4 to 62·6 F.), assume the molecular constitution of the 7-atom hydrate; and, further, that, when this salt is deposited, the non-crystallised portion of the solution is the mother liquor of the 7-atom salt. He determines the solubility of this 7-atom hydrate by carefully withdrawing, by means of a warm pipette, a little of the so-called mother liquor at a known temperature, weighing it, evaporating it to dryness, and so calculating the solubility of the 7-atom salt in terms of the anhydrous salt obtained by the evaporation.

But, suppose the so-called mother liquor resting on crystals of the 7-atom salt is once more a solution of the anhydrous salt, what then becomes of the table of solubilities? and what of the theory of molecular change at 17° or 18° C.?

I made a solution of about 2½ parts of the 10-atom hydrate in one part of water; boiled it, and filtered it into three test-tubes, which were then plugged with cotton-wool, and placed upright in a rack close to the window to cool. They were then put into water at from 35° to 40° F., when octohedral crystals of the anhydrous salt were deposited in all three solutions. The tubes were now returned to the rack, when, in a few hours, the 7-atom salt was formed, a few prisms with oblique summits being well marked. The tubes were now put into a freezing mixture, at 20° F., when another shower of beautiful octohedra took place. I need hardly say that, if the molecular change insisted on by M. Löwel had taken place, and if the solution resting on the 7-atom hydrate had been its mother liquor, crystals of the 7-atom hydrate must have been thrown down, and not those of the anhydrous salt.

The tubes were again returned to the rack; when, after some time, another formation of the 7-atom hydrate took place. Next day, in order to be quite sure that it was the 7-atom salt at the bottom of the tubes, the cotton-wool plug was removed from one of them, when crystallisation of the 10-atom salt at once set in from the surface, and, proceeding downwards, converted the deposit into an opaque, chalky mass, or, as Ziz says, "like boiled white of egg," the crystallisation above it being translucent, like ground glass. The two remaining tubes were put into a freezing mixture at about 10° F. The crystals were long in coming, but at length a few well-defined octohedra fell down from the solution in each tube.

I remember that Professor Daniell, of King's College, was in the habit of introducing the same experiment, under different forms, even to variations in the shape of a bottle or flask, in order that his pupils might be allured by the principle involved, rather than by the form of the apparatus. Profiting by this useful example, I prepared a solution of about 4 salt to 1 water, in flasks, where, with much less depth, there was a greater body of solution than in the tubes. The flasks were exposed to the cold of the window-ledge, where they remained all night. Next morning there was a copious deposit of the 7-atom salt. On putting one of the flasks into a freezing mixture, at 25°, F., there was an abundant liberation of anhydrous crystals from the so-called mother liquor of the 7-atom salt, but which is really a solution of the anhydrous salt.

I ought, perhaps, to apologise for drawing thus freely on my note-books for these experiments. My best excuse is that they have not been previously published. In my memoir on "Supersaturated Saline Solutions," I was satisfied with the statement, accompanied by one experiment only, that solutions of Glauber's salt, when removed from the influence of nuclei, hold anhydrous salt in solution, and deposit it

on a proper reduction of temperature. Such was my conclusion two years ago; and I see no reason to alter my opinion now. On the contrary, that opinion is strengthened by experience, and by recurring to Professor Daniell's favourite process of varying and multiplying the means, so as to become more secure of the end. One such variation I cannot help giving, since it leads to the same conclusion, by means of a physical test of great practical value.

In the experiments for determining the elasticity of steam from pure water, the elasticity is diminished for any given temperature, if a small portion of a salt, such as soda, soluble in water and not capable of rising in vapour with it, be allowed to ascend to the top of the mercurial column, the column rises, thereby indicating a diminished elasticity of the steam. The adhesion of the soda to the water tends to restrain the water from evaporating, and this tendency is a measurable force, and here measured; for it partly balances the tension of the water, or its tendency to emit steam, and thus makes the steam-emitting tension of a solution of soda measurably less than that of pure water at the same temperature.

Now, it is clear that, if, instead of soda, Glauber's salt be used in experiments of this kind, there would be a smaller amount of diminution in the elasticity of the steam if the salt in solution retained its water of crystallisation than if it entered into solution in the anhydrous form. In a valuable series of experiments by Wüllner,* it appears to have been established that, for solutions of various strengths (such as 10, 20, 30, &c. per cent of Glauber's salt in pure water), and at various temperatures, from 10° to 100° C., the diminution in the elasticity of the steam is proportional to the quantity of *dry* salt in solution; and, further, that, at the point of maximum solubility of this salt, no molecular change takes place, or it would have impressed itself on the curve which represents the elasticity of the steam. The general conclusion for the salts tried is that the action of efflorescent salts is expressed in terms of the dry salt, while, for deliquescent salts, it is in terms of the hydrated salt.

I cannot wind up without entering a protest against the doctrine involved in the foot-note to M. Dubrunfaut's paper (Chemical News, vol. xx., p. 241; *Am. Repr., Jan.*, '70, page 19). which amounts to this—that, if a man repeat the published experiments of others without knowing it, he is entitled to claim the results as original discoveries of his own. I am quite aware that credit is given to M. Löwel in our text-books for discoveries that belong to previous inquirers; and, with all due respect for him, I cannot help thinking that he would have improved his work by quoting his authorities more freely. Now, at the time when Löwel commenced his labours, a large number of well-attested facts had been established by such men as Ziz, Ogden, Faraday, Turner, Graham and others. Löwel does refer incidentally to Ziz and Faraday, proving that he knew something of their results; and yet we are now coolly told that all those honored names are to be swept away, and Löwel only referred to as the discoverer of the leading phenomena of supersaturation. If such reasoning and practice were applied in literature as they are on some occasions in science and the useful arts, we should realise the condition of the modern epic poet, who declared that he had splendid thoughts, only those scoundrels, the Ancients, had already appropriated them.

Highgate, N., November 24th, 1869.

* *Pogg. Ann.*, ciii., 529, and cx, 564.

ON THE

COMBINATIONS OF PHOSPHATE OF LIME AND SULPHUROUS ACID.*

BY DR. B. W. GERLAND, MACCLESFIELD.

Phosphate of lime, in whatever state it may be, readily dissolves in an aqueous solution of sulphurous acid. The solution can be obtained of great strength; thus, from freshly precipitated tribasic phosphate of lime, a liquor was prepared of 1·3 specific gravity; and, from bone-ash, one of 1·1708 specific gravity. The former contained, in 1000 c. c.—

	grms.
Sulphurous acid	218·38
Sulphuric acid	0·70
Lime	101·79
Phosphoric acid	82·89
	403·76

These figures agree tolerably with the formula—

$$3CaO,PO_5+6SO_2,$$

as the comparison with the calculated table shows—

$3CaO$	84	98·20
PO_5	71·4	82·89
$6SO_2$	192	224·45
		405·54

The solution of bone-ash, in sulphurous acid of 1·1708 specific gravity, was found to contain, in 1000 c.c.—

	grms.
Sulphurous acid	141·82
Sulphuric acid	trace
Phosphoric acid	47·42
Magnesia	2·79
Lime	59·69
	251·72

The formula $3CaO,PO_5,6SO_2$ requires, for 47.42 PO_5—

	grms.	
Lime	55·78	
Phosphoric acid	47·42	
Sulphurous acid	127·50	
		230·70
The excess of lime in the analysis is		3·91
and magnesia		2·79
These two would require sulphurous acid		8·73
Excess of sulphurous acid		5·58
		251·71

The bone-ash which was left undissolved by the sulphurous acid had lost all its magnesia, a circumstance which accounts for the large amount of magnesia in the liquor.

The proportion of $3CaO,PO_5$ and SO_2 varies according to the strength of the liquor; if the latter is, for instance, 1·060 specific gravity, 5eq SO_2 dissolve $3CaO,PO_5$; and, in still weaker solutions, we find only 4eq SO_2 for $3CaO,PO_5$.

These solutions possess very interesting reactions, some of which are the following.

A neutral solution of ferric chloride precipitates straw-coloured phosphate of iron, and, if added in proper quantity, the liquor is free from both iron and phosphoric acid. The precipitate, after washing and drying over sulphuric acid, is free from lime and sulphurous acid. Its analysis agrees well with the formula Fe_2O_3,PO_5+5HO.

* Read before the Manchester Literary and Philosophical Society Nov. 16th, 1869.

Acetate of copper colours the sulphurous acid solution, when added in small quantity, intensely green; a further addition produces a thick yellow precipitate, which rapidly changes in contact with air, and thereby becomes green. Acetate of lead also produces a thick precipitate of white colour. These precipitates contain, besides the metallic oxide, lime, phosphoric and sulphurous acids. Chloride of barium precipitates the solution directly, and chloride of magnesium after some standing.

The solution of phosphate of lime in sulphurous acid possesses the taste and smell of the acid, but to a much smaller extent than an aqueous solution of the acid containing the same amount of sulphurous acid.

Under the influence of boiling heat, the phosphate solution is decomposed slowly, sulphurous acid escapes, and a heavy white crystalline precipitate is formed. Under the microscope, it appears as composed of crystals of the hexagonal system, like those of rock-crystal. Washed and dried over sulphuric acid, it contained—

Sulphurous acid	15·61
Sulphuric acid	0·23
Lime	39·89
Phosphoric acid	34·48
Water	9·08
	99·29

These numbers agree with the formula—

$$3CaO,PO_5,SO_2,2HO,$$

the calculated numbers of which are—

SO_2	32	15·58
$3CaO$	84	40·89
PO_5	71·4	34·76
$2HO$	18	8·77
	205·4	100·00

This sulphited phosphate of lime has no smell or taste, and is distinguished from all sulphites by its stability. Heated in an air-bath for three hours to 130° C., it lost 0·64 per cent of water; but the amount of sulphurous acid remained unchanged, neither had a humid atmosphere the slightest effect upon it. The water is held in intimate combination, and is only expelled at a higher temperature when it is accompanied by fumes of sulphur, sulphuric and sulphurous acids. The residue contains, besides lime and phosphoric acid, sulphate and sulphide of calcium.

Cold water has no effect upon the sulphited phosphate of lime. After long-continued boiling, the air being excluded, a partial decomposition takes place, which is shown by the following analysis.

1000 c.c. of the water contained—

	grm.
SO_2	0·2680
SO_3	0·0470
PO_5	0·1181
CaO	0·2045

And an undetermined quantity of the undissolved residue contained—

SO_3	0·03464
PO_5	0·12393
CaO	0·13916

The constituents are, therefore, in the following proportions:

In the solution—

1 eq. PO_5 : 4·35 eq. CaO : 5·07 eq. SO_2 : 0·71 eq. SO_3;

And in the residue—

1 eq. PO_5 : 2·85 eq. CaO : 0·623 eq. SO_3.

The sulphite, which withstands the action of the atmosphere indefinitely, is rapidly oxidised when incorporated with soil. A quantity was buried in a heavy clay soil (which, as was ascertained previously, contained no lime and phosphoric acid soluble in dilute hydrochloric acid), and was exhumed after two months, when it was found to be free from sulphurous acid. The sample was selected for analysis with the least possible quantity of soil. It contained—

	per cent.
SO_3	18·59
PO_5	24·58
CaO	33·66

The oxidising process which has taken place in this instance may be expressed by the formula—

$$3CaO,PO_5,SO_2,2HO + O = 2CaO,HO,PO_5 + CaO,SO_3 + HO.$$

The original substance contained 34·5 per cent PO_5 and 15·8 per cent sulphurous acid, equal to 19·75 per cent SO_3. The sample for the last analysis ought, therefore, to contain, for 24·58 per cent PO_5, 14 per cent SO_3; but, according to the analysis, it contains 18·59 per cent—that is, 4½ per cent more. This excess of sulphuric acid proves that it is dissolved at a slower rate than the phosphoric acid. Calculating the amount of lime which the acids of the analysis require, we find, for—

18·59 SO_3 as CaO,SO_3	13·01	per cent CaO,
And for—		
24·58 per cent PO_5 as $2CaO,PO_5$	19·28	" "
Total	32·29	"

This number is less than the quantity of CaO found by 1·37 per cent, which excess is to be accounted for by the tendencies of the dibasic phosphate to undergo a partial decomposition under the action of water, in consequence of which a compound of higher basicity is left undissolved.

It is, therefore, evident that the new compound will, in the soil, act as a soluble phosphate of lime; it has, in fact, for several seasons been used as a manure, and has given great satisfaction.

Strong mineral acids dissolve the sulphited phosphate of lime under effervescence of sulphurous acid. Acetic acid has no effect in the cold, and dissolves it only after long-continued boiling, but much easier when the air has access. Oxalic acid decomposes it a little quicker. Chlorine gas is readily absorbed by the new phosphate. After the action is completed, it contains no more sulphurous acid, but only traces of sulphuric acid. Of the phosphoric acid, only a small portion has become soluble (about 1–12th). This decomposition still occupies my attention.

A weak solution of iodine, such as Mohr's standard solution, acts readily upon the sulphited phosphate of lime, as represented by the formula—

$$3CaO,PO_5,SO_2,2HO + I = CaO,2HO,PO_5 + CaO,SO_3 + CaI.$$

The colour of the iodine disappears as long as there is substance left undissolved. This is a convenient method for estimating the sulphurous acid of the compound; but, as the last portions are only slowly acted upon by the iodine, it is advisable, in order to save time, to add a drop of hydrochloric acid, when the iodine begins to disappear slowly: it does not interfere with the accuracy of the experiment.

The sulphited phosphate of lime, exposed to an atmosphere containing ammonia, rapidly absorbs the latter, but, at the same time, an equivalent quantity of sulphurous acid seems to be oxidised. A sample of the

substance was placed under a glass shade with pieces of carbonate of ammonia and water for four weeks, and subsequently over sulphuric acid for two days, and yielded, by analysis, the following results :—

	per cent.
Lime	39·08
Sulphurous acid	2·50
Ammonia	5·60

The new sulphite possesses remarkable antiseptic and disinfecting powers, and, on this account, will command a general interest. The efficacy of sulphurous acid as a disinfectant is well known, and it would be more appreciated if it could be conveniently applied. The aqueous solution is expensive by transport; it is very changeable, and, in many cases, it is unavailable, on account of its pungent smell, whilst, for medical purposes, it can only be used in exceptional cases, in consequence of its irritating action. The sulphites are still more changeable. Exposed to the air, they are acted upon by carbonic acid and by oxygen; and, when mixed with decaying organic matter for disinfecting purposes, they very often increase the mischief, and sometimes cause an abundant escape of sulphuretted hydrogen. The compound of phosphate of lime with sulphurous acid has none of these disadvantages. Acids, as well as ammonia, are neutralised by it. From a sanitary point of view, ammonia is particularly objectionable: being a product of putridity, it helps to accelerate it, and also serves as a vehicle for disseminating other products which, without it, would not be volatile, or only so to a less degree.

The sulphited phosphate, when applied to putrid matter, will probably do its first service by neutralising the ammonia present (including compound ammonias), and also prevent its further formation, as the test-paper will show. The smell will soon cease, or, at least, be greatly diminished and altered, and the mass will be safe for a long time, so that it may be removed or dried without danger or inconvenience. I must here remark that large quantities of putrid matter in open spaces are more completely and speedily disinfected by small portions of the phosphate than samples in glass bottles. The compound recommends itself as a disinfectant by its physical properties. It is a clean white powder, which stains and soils nothing, dusts off garments or carpets, leaving no mark; it is free from smell and taste, and harmless to animal life.

It proves itself invaluable in stables and shippons. The air of these localities is generally highly charged with ammonia, yet the tenants are expected to live and thrive. A regular application of a small quantity of the phosphate will prevent the loss of ammonia, it will sweeten the air, and enrich the manure with phosphoric acid, thus being of threefold advantage. The loss of ammonia from the dung is not inconsiderable; it is also the most valuable constituent of it, being worth more than 9d. per lb. to the farmer.

The solution of phosphate of lime in sulphurous acid also possesses disinfecting powers, and acts, in many cases, even with greater energy than the powder. It might be used with advantage as being applicable to places which could not be reached by the other.

The neutrality, regularity of composition, utter harmlessness, and freedom from smell and taste, recommend the sulphited phosphate of lime for trial in therapeutics. It would be of interest to investigate it in relation to putrid puerperal fevers, pyæmia, &c.

It appeared to me not unlikely that a compound of phosphate of lime with 2 eq. sulphurous acid might exist. Numerous experiments, made with a view of preparing the same, have entirely failed; but some of the results are interesting as showing unexpected reactions of these compounds.

The sulphite of phosphate of lime is not acted upon by the solution of phosphate of lime in sulphurous acid. Sulphurous acid gas is only absorbed in very small proportion by either dry or wet bone-ash. This phosphate of lime is not even converted into the sulphurous acid compound by digestion with the sulphurous acid solution. If sulphurous gas is passed through water holding an excess of phosphate of lime in suspension, the latter remains unchanged.

Under the receiver of an air-pump, the sulphurous acid solution forms good sized crystals, probably belonging to the hexagonal system. Analyses of crystals of different preparations gave varying results, which, however, agreed tolerably with the formula—

$$x(3CaO,PO_5,SO_2,2HO)+y(CaO,SO_3,2HO)+z(CaO,SO_2+5HO).$$

The more crystals separate from the solution, the more the phosphoric acid accumulates in the latter. In one instance, lime, phosphoric acid, and sulphurous acid were almost in proportion of their equivalents.

Alcohol precipitates the solution of phosphate of lime in sulphurous acid. The analysis of the precipitate gave 24·8 per cent of water, and no more sulphurous acid, in proportion to lime, than the above-described powder.

The solution is also precipitated by a current of an indifferent gas, like hydrogen. The analysis of the precipitate gave figures from which no simple formula can be calculated. The amount of phosphoric acid, in proportion to the lime, is greater than that corresponding to tribasic phosphate; and the amount of sulphurous acid is much less than that of the precipitate obtained by boiling. In accordance with the foregoing, the solution, after treatment with hydrogen gas, was found to contain less phosphoric acid, in proportion to the lime, than before.

Under reduced pressure, the phosphate solution boils easier, and the separation of the precipitate takes place more readily. This precipitate contains less sulphurous acid and more water than corresponds to the formula $3CaO,PO_5,SO_2,2HO$.

I experienced so much difficulty in preparing pure tribasic phosphate of lime, that I was obliged to use, for most of my experiments, the phosphate offered by nature in bones and bone-ash.

The compounds of phosphate of lime with sulphurous acid undoubtedly possess great scientific interest. This consideration, as well as the importance they are likely to attain for agricultural and sanitary purposes, as they have now become articles of commerce, has induced me to lay before you the results obtained so far in my investigation, with the prosecution of which I am still occupied.

THE COMMITTEE OF THE BRITISH ASSOCIATION ON THE TREATMENT AND UTILISATION OF SEWAGE

The following letter has been issued by the above committee to the municipal and sewer authorities throughout the country :—

I have the honour to inform you that, last year, at the meeting of the British Association, at Norwich, a committee was appointed to report on the treatment

[English Edition, Vol. XX., No. 523, pages 270, 271.]

and utilisation of sewage. In the first instance, a grant of £10 was placed at the disposal of the committee, with which to defray the cost of printing and postage incidental to the collection of preliminary statistical information. Through the kindness of Her Majesty's Government, the committee was enabled to obtain reports respecting the methods of dealing with town refuse practised in most civilised countries; and that information has now been collected in a more complete form than hitherto existed in any country.

This preliminary work being completed, the committee was re-appointed at the meeting of the British Association this year, at Exeter; and the inquiry was considered to present such important features of social and scientific interest, that the sum of £50 was voted towards enabling the committee to enter more fully and practically upon the investigation of this subject. The British Association, being a purely scientific body, has not at its disposal funds which would be adequate or applicable for the full prosecution of this very large and pressingly-important inquiry. The committee, nevertheless, desires to take advantage of the opportunity created by the British Association to investigate the entire subject in all its bearings—whether chemical, physiological, or engineering, sanitary, municipal, or agricultural—and in a manner worthy of the body they represent.

It is unnecessary to point out the enormous importance, especially at the present time, of a full and complete investigation of this question by the light of the knowledge and experience now gained in the several departments above alluded to. But, properly to carry out such an inquiry with a practical end, numerous observations, gaugings, and experiments, aided by simultaneous analyses, are essential; and these cannot be accomplished (especially the analyses) without the continued aid of efficient and, therefore, highly-paid assistants. Moreover, from time to time, it may be necessary for the committee to purchase expensive apparatus, and to subject various inventions and processes to a thorough and complete test; for it is the desire of the committee, not only to ascertain, as far as possible, the causes of the sanitary inefficiency of existing works, but also to inquire into every suggestion which affords promise of practical utility, in order that this investigation may be searching, the report practical, and any recommendations that may be made authoritative.

It is the wish of the several members of the committee to devote, to the utmost of their ability, their personal attention to the work thus sketched out; but the expenses absolutely necessary to enable them to conduct so extended an inquiry cannot but be very heavy, and, unless they are able to secure an adequate fund, they must abandon the attempt to investigate the subject in this broad and comprehensive manner. However, since there is no subject of greater practical and social importance to the public generally, and thus to the various municipal authorities and other governing bodies throughout the country, it is believed that many will share the opinion expressed at the recent meeting of the British Association, at Exeter—that the existence of this committee affords a specially favourable opportunity for such a wide inquiry; and, for that reason, its members confidently appeal to those authorities who are officially interested in the subject to supply the funds necessary for the investigation.

I am, therefore, desired to request that you will kindly submit this letter to the body you represent; and I venture to hope you will give the committee the benefit of your good offices in procuring a subscription proportionate to the population of your town or district.

. . . . I am, &c.,

George F. Barnes,
Honorary Secretary, *pro tem.*

22, Whitehall Place, London, S. W.,
November 18th, 1869.

CHLORINE AND METALLIC SODIUM.

BY J. ALFRED WANKLYN, F.C.S.

When chlorine gas is passed over metallic sodium—even when the metal is fused, and, whilst in a state of fusion, shaken in contact with the gas, so as to expose fresh metallic surface—there is no action. A glass vessel containing a piece of sodium was weighed; and, after the transmission of chlorine under the circumstances above named, it was re-weighed.

	grms.
Weight before the action of chlorine	7·847
Weight after the action of chlorine	7·863
Gain	0·016

The quantity of metallic sodium taken for the experiment was 0·770 grm.

SPECTROSCOPIC NOTES.*

BY PROFESSOR C. A. YOUNG,

OF DARTMOUTH COLLEGE.

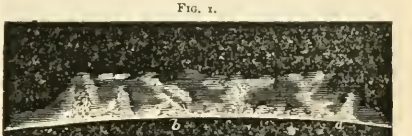
September 4th, 1869.—Prominences were noted on the sun's limb at 3 p.m. to-day in the following positions, angles reckoned from North point to the East:—

1. +70° to +100°, very straggling, not very bright.
2. −10°, large and diffuse.
3. −90°, small, but pretty bright.

September 13th, 1869.—The following protuberances were noted this p.m.

1. Between +80° and +110°, a long straggling range of protuberances, whose form was as in Fig. 1. I dare not profess any very extreme accuracy in the drawings, not being a practised draughtsman, but the sketch gives a very fair idea of the number, form, and arrangement of the immense cloudy mass, whose height

Fig. 1.



was about 50″ and its length 330″ (22,500 miles by 1,350,000). The points *a* and *b* were very bright.

2. +135° small, but very bright at the base, of this form (Fig. 2).

3. −85° of this form (Fig. 3).

Fig 2.

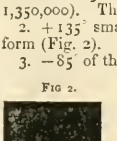
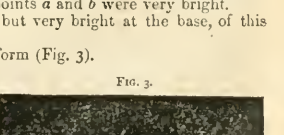


Fig. 3.



* From the October number of the *Journal of the Franklin Institute.* Kindly communicated, with the cuts, by Professor Morton.

The dark spot, marked *c*, was very curious, reminding one strongly of the so-called fish-mouth in the nebula of Orion. I saw no change in it for 20 minutes. On the other hand, the first series mentioned were changing rapidly, so that at five o'clock the sketch which was drawn at two was quite inapplicable, only the general features remaining unaltered.

4. −128°, about 20″ high, forked, thus:

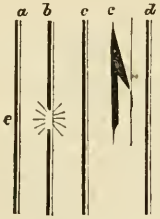
Fig. 4.

The structure was *cirrus* in every one but No. 3, which seemed more like a mass of cumulus.

To-day, for the first time, I saw b_1 reversed in the chromosphere when the slit was tangent to disc; 1474 was easy; the new line at 2602 cannot be detected as yet.

At 2·25, while examining the spectrum of a large group of spots near the sun's western limb, my attention was drawn to a peculiar double *knobbiness* of the F line (on the sun's disc, not at the edge), represented by Fig. 5, *a*, at the point *e*. In a very few moments a brilliant spot replaced the knobs, not merely interrupting and reversing the dark line, but blazing like a star near the horizon, only with blue instead of red light; it remained for about two minutes, disappearing, unfortunately, while I was examining the sun's image upon the

Fig. 5.



graduated screen at the slit, in order to fix its position, which was at −82½, about 43″ from the edge of the limb, about 15″ inside of the inner edge of the spot-cluster. I do not know, therefore, whether it disappeared instantaneously or gradually, but presume the latter. Fig. 5, *b*, attempts to give an idea of the appearance. When I returned to the eye-piece, I saw what is represented at Fig. 5, *c*, &c. On the upper (more refrangible) edge of F, there seemed to hang a little black mote, making a *barb*, whose point reached nearly to the faint iron line just above F. As given on Angström's atlas, the wave-length of F is 486·07, while that of the iron line referred to is 485·92 (the units being millionths of a millimetre). This shows an absolute change of 0·15 in the wave-length, or a fraction of its whole amount, represented by the decimal 0·00030, and would indicate an advancing velocity of about 55·5 miles per second in the mass of hydrogen whose absorption produced this barbed displacement.

The barb continued visible for about five minutes, gradually resolving itself into three small lumps, one on the upper and two on the lower line, Fig. 5, *d*. In about ten minutes more, the F line resumed its usual appearance. I did not examine the C line, as I did not wish to disturb the adjustments and risk losing some of the curious changes going on under my eye.

After the close of this strange phenomenon, I examined, with our large telescope of 6-inch aperture, the neighbourhood in which this took place, and found a very small spot exceedingly close to, if not actually *at*, the place. This was at 2.45. At 5.30 it had grown considerably.

Undoubtedly, the phenomenon seen was the same referred to by Mr. Lockyer, when he speaks of often seeing the bright lines of the prominences not only at the sun's limb but on his disc. It is the only time I have had the good fortune to see it as yet.

The common fire-fly gives a continuous spectrum without any trace of lines, either bright or dark. It is noteworthy that this spectrum lies almost entirely between the lines C and F, the portion of the luminous diaphason where the thermal and actinic effects are nearly *nil*, and where almost all the energy expended is effective as pure light. How different from our artificial modes, in which not more than one-tenth of one per cent of the expended energy appears as light, the rest being mostly wasted in heat, and partly in actinism.

Hanover, N. H.,
September 18th, 1869.

ON SOME TECHNICAL APPLICATIONS OF THE SPECTRUM MICROSCOPE.*

BY H. C. SORBY, F.R.S., ETC.

My object in publishing the following paper is to show that the spectrum microscope may be applied with advantage in several departments of technical inquiry, and more especially to describe the methods useful in such investigations. Since these will be much more readily understood by means of practical illustrations, I shall not make many general introductory remarks, but reserve an account of each particular process until I come to those practical questions which require its adoption.

In the first place, I beg to refer to my papers "On a Definite Method of Qualitative Analysis of Animal and Vegetable Colouring Matters,"† and "On the Colouring Matters of Blue Decayed Wood" ‡ since much that I shall describe will be a continuation and application of what they contain. I shall make use of the same scale for measuring the position of the absorption bands, and the same notation and symbols to express the varying power of absorption in different parts. This scale is an interference spectrum with dark bands, which divide the whole visible spectrum into twelve portions of equal optical value; and it is so adjusted that the sodium line, D, is situated exactly at 3½. On this scale the principal Fraunhofer lines occur as follows:—

A .. $\frac{3}{4}$	B .. $1\frac{1}{2}$	C .. $2\frac{3}{8}$	D .. $3\frac{1}{2}$
E .. $5\frac{11}{16}$	*b* .. $6\frac{7}{16}$	F .. $7\frac{1}{2}$	G .. $10\frac{5}{8}$

The only objection to this scale is that its accuracy is dependent on the careful preparation of the plate of quartz. I have myself made several perfectly alike and accurate, and nothing but proper care is required. When once accurately made, no scale could be more convenient, since the bands occur at equal optical intervals over the whole spectrum, and are quite distinct when the slit is opened rather wide, which is sometimes a great advantage. In these two respects it is far superior to any other scale hitherto proposed.

The intensity of absorption will be expressed by means of dots, hyphens, and dashes; thus:—

* Communicated by the author, having been published in the *Quarterly Journal of Microscopical Science*, vol. ix., new series, p. 358.

† *Proceedings of the Royal Society*, 1867, vol. xv., p. 432.

‡ *Quarterly Journal of Microscopical Science*, January, 1869.

Not at all shaded		Blank space.
Very slightly shaded	.	Single dot.
Slightly shaded	..	Double dots.
Moderately dark	- -	Double hyphens.
Very dark	—	Single dash.

When these symbols are printed *between* numbers they signify that there is a more or less strong absorption between those points of the spectrum as measured by the above-named scale; whereas when they are printed *under* numbers they signify that there is a distinct absorption band, of the intensity expressed by the different symbols, the *centre* of which is situated at that point of the scale indicated by the figures. This latter method is extremely simply and convenient, and often serves to express all that is requisite. It may, perhaps, appear imperfect to those accustomed to the study of the spectra of substances in the state of incandescence, but it is in all respects well adapted for the study of the spectra of solutions, in which a slight difference in the character of the solvent often makes far more difference in the position of the bands than any that could result from errors due to the employment of such a scale and notation. To hold the liquids under examination, I in most cases employ narrow, deep cells, usually one-eighth of an inch diameter, and half an inch deep, so mounted that they can be examined either in the line of the length or at the side; but occasionally I use rather wider, as much as two and a half inches long.

By using these narrow cells very much less material is required for successful examination, which is not only most important when very little is at command, but even in other cases often effects a considerable saving of time in filtration and evaporation.

I shall divide my subject into three principal heads, viz., 1. Various facts connected with wine; 2. Those relating to malt liquors; and—3. Such as illustrate the methods that may be employed to detect adulteration in various substances used as food or medicine.

1. *On the Colouring Matters of Wines.*

The pure colour of fresh dark grapes is best prepared by removing the skins, heating them in alcohol, evaporating the solution to dryness, redissolving it in a little water, filtering, and again evaporating to dryness in a small saucer, in which the colour may be kept as a stiff syrup for many months without material change. It belongs to the group of colours which I call group B in my paper in the *Proceedings of the Royal Society*—that is to say, sulphite of soda produces no immediate effect when added to a solution rendered alkaline by ammonia; but when added to one made acid with citric acid, it almost immediately removes the detached absorption in the green, so that the solution becomes very pale.

Since this colour of dark grapes is purple when dry and quite neutral, it may be called *Vitis purple*. I have not yet met with it in any other fruit, unless it be in that of the common crowberry (*Empetrum nigrum*). One of its peculiarities is that it easily passes into insoluble modifications. It belongs to my sub-group B alone, since it does not give any decided narrow absorption band in an alcoholic solution, when either neutral or with excess of ammonia. Such colours are amongst the most difficult to distinguish from one another, and I have not yet been able to discover any more satisfactory method than the following:—A slight excess of ammonia should be added to the alcoholic solution; made so dilute that the absorption in the orange part of the spectrum is distinct, but yet very far from black, and the position of the limit of the absorption towards the red end carefully measured and recorded, thus—$1\frac{5}{8}$ . . . .

The same limit should also be ascertained after considerable excess of hydrochloric acid has been added to the solution, both in water and in alcohol; which solutions sometimes give the same, but sometimes materially different, spectra. These various limits of absorption vary with the depth of colour, but by taking care to have solutions which give equally strong absorptions, and comparing them side by side, it is often very easy to distinguish from one another very closely allied colours—for example, that of dark gooseberries from that of grapes, or that of fresh grapes from that of new dark wines. The difference between these latter is proved, not only by the spectra, but also by other facts.

In my paper in the *Proceedings of the Royal Society* already cited (p. 443), I showed that when certain colouring matters are dissolved in water or alcohol, they give deep-coloured solutions, which rapidly fade to nearly colourless; but when these faded solutions are evaporated to dryness, the colour is completely restored to its original state, and is also made quite as dark as if it had never faded, by adding some strong acid; so that the fading is not due to decomposition, but to a molecular change rapidly taking place in dilute solutions. The colour of fresh grapes is an example of this; and by comparing with a standard which did not fade, the solution immediately after the colour was dissolved, and the same after less than an hour, when no further change occurred by keeping it longer, I found that the faded required fully five times the thickness to give the same intensity of absorption at the yellow end of the green. On the contrary, new dark wines evaporated to dryness do not fade at all in such a manner when re-dissolved in water.

This colour of new wines appears to be produced at a very early part of their formation. By dissolving the colour of the fresh grapes in the juice, adding a little yeast, and keeping the solution warm for a few days, the colour appeared to be changed into that found in new wines, and did not fade at all when re-dissolved in water. The colour kept as dry syrup for three years showed a similar change. I think it must be, therefore, due either to fermentation or to a slight oxidisation. I am much inclined to adopt the latter explanation, for if citric acid be added to an aqueous solution of the fresh colour, and then a small quantity of hypochlorite of soda, the colour is changed from pink to pink-red, the absorption is found to extend more towards the red end, and to be more uniform over the green and blue; in all which particulars it corresponds with the spectrum of new wine. No such change occurs when the wine is treated in the same manner as though this alteration had already taken place. Both these colours belong to my group B; but when either is still further oxidised by means of rather more hypochlorite of soda, a sort of orange colour is produced, which seems to correspond with that of port wine kept for twenty years or more in the cask; and when still further changed, it becomes quite pale, like very old wines. The following table will show these facts more clearly:

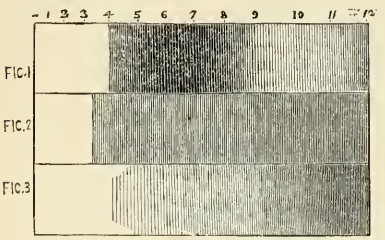
Colour of dark grapes in citric acid and water	4	..	$4\frac{1}{2}$	-	-	$8\frac{1}{2}$	..	11 - -
Ditto, after adding a little hypochlorite of soda	$3\frac{1}{4}$	..	$3\frac{3}{4}$	-	-	- -		
New natural port wine	$3\frac{1}{4}$	..	$3\frac{3}{4}$	-	-	-		
Ditto, after adding a little hypochlorate of soda	$3\frac{1}{4}$	..	$3\frac{3}{4}$	-	-	-		
Colour of dark grapes with more hypochlorite of soda	5	..	6	-	-	10	—	
New natural port wine with ditto	5	..	6	-	-	10	—	
1834 port from the cask	5	..	6	-	-	10	—	

Since this change in the spectrum depending on the

[English Edition, Vol. XX., No. 524, pages 279, 280.]

state of oxidisation is of considerable interest as illustrating a general law, I here subjoin a woodcut,* in order to render more intelligible to those not accustomed to the use of the symbols employed in the above table. Fig. 1 shows the spectrum of the colour of dark grapes in its natural state, in citric acid and water. Fig. 2 is the spectrum of the oxidised modifications met with in new wines; and Fig. 3 that of the per-oxidised colour found in very old wines, or formed by the more complete artificial oxidisation of the other two.

This colour of very old wine belongs to my group C, and is not changed by adding sulphite of soda to an acid solution; whereas, as already mentioned, the characteristic colour of very new wine belongs to my group B, and if it could be obtained in a pure state, would probably become nearly colourless on the addition of the sulphite. This difference between the colour of new



and old wine has enabled me to contrive a method by means of which I can ascertain the approximate age of port wine kept in the cask. In these experiments I have been very much assisted by my friends, Mr. Joseph Prestwich, F.R.S., and Mr. Alexander Hay, of Sheffield, who have most kindly supplied me with the requisite samples.

On the Age of Dark Wines.

In order to obtain good results considerable care is required, and after trying several methods I found the most satisfactory was as follows:—I have two experiment cells one inch long, made from stout tube, having an internal diameter of about a quarter of an inch. Both ends are cut square, and one is fastened to a piece of glass like a microscopical object by means of purified gutta percha. This I find a most valuable cement for such purposes, since it resists the action of alcohol, acids, and alkalies. The glass must be heated until the gutta percha is sufficiently soft. One of the tubes is carefully graduated into ten equal parts, and the other left plain. Wine in its natural state is often much too dark coloured to enable us to recognise the effect produced by adding sulphite of soda, when we examine the spectrum of the thickness of one inch. It is, therefore, requisite to dilute it with so much of a mixture of one part of alcohol with three of water that the spectrum of the light which has passed through the experiment cells may show a strong, but by no means complete, absorption of the light in the yellow and in the yellow end of the green. After diluting some of the wine to this extent, and adding so much citric acid that it may have a very strong acid reaction, it should be poured into two test-tubes, powdered sulphite of soda dissolved in one, and the other kept without. Though the sulphite may produce a very considerable change at once, the alteration is not complete for a while, and therefore it is best to keep the solutions for an hour or two in the tubes, corked up to prevent evaporation. The point to be then determined is, how much less thickness of the diluted wine to which no sulphite has been added will give exactly the same intensity of absorption in the yellow, and in the yellow end of the green, as the thickness of one inch of the same acted on by the sulphite of soda. The ungraduated tube should, therefore, be filled with the latter, and a small piece of thin glass placed on the top, so that the light may pass through exactly one inch in thickness of the liquid, and none run out when the tube is placed in an inclined position on the side stage of the spectrum eye-piece. The diluted wine should then be introduced into the graduated tube, which is placed nearly vertically on the ordinary stage of the microscope, and the depth of the liquid carefully regulated by means of a pipette, so that the intensity of the absorption in the two spectra may be exactly the same in the yellow and in the yellow end of the green. The light must be of the same intensity in both spectra; and, therefore, it is also particularly necessary so to regulate the instrument that the transmitted red rays may be of exactly the same brilliancy. The accuracy of this experiment is limited by the difficulty of recognising when the transmitted and the absorbed rays are equal in both spectra, and by its being difficult to determine the depth of the diluted wine to less than 1-100th of an inch. The actual value of the measurements varies, to some extent, according to the manner in which the experiments are made; and, therefore, I strongly advise any one who may wish to employ this method to prepare for himself a table of the comparative amount of change of wines of various ages.

When sulphite of soda is added to a faded solution of the colouring matter of fresh dark grapes it is changed to a pale orange yellow, which colour is, I believe, due in great measure to the presence of the same yellow substance as is met with in green grapes, so that the intensity of absorption is reduced to about 1-10th, or from 1·00 to 0·10. In the case of the perfectly new wine prepared by myself, the intensity of absorption was reduced from 1·00 to about 0·22. My experiments with the wines of commerce were chiefly made in April, 1868. The newest port wine that I was able to examine was of the vintage of 1866, and therefore about one year and a half old, and even this contained a good deal of the C colour. I examined several specimens of the same vintages of various older dates, which differed considerably in general colour and character, but when all had been kept for the same time in the casks I did not find any material difference in the general results. From the manner in which the experiments were made, the change produced by adding the sulphite of soda is referred to the amount of the C colour taken as unity; and, assuming that the extent to which the wine has been altered by keeping is the difference between the amount still unchanged and unity, the numbers given indicate the relative changes produced by the slow action of the air, but they can only be looked upon as expressing the rate of one particular kind of change. The following table has been constructed from the whole of my observations, so as to give a good general illustration of the subject.

* We are indebted to Messrs. Churchill and Sons for the use of this woodcut.

Column 1 shows the age of the wine in years and the date of the vintage.

Column 2 gives the thickness of the diluted wine without sulphite, which produced the same intensity of absorption as 1·00 inch of that to which the sulphite had been added.

Column 3 shows the difference between the values in column 2, divided by the number of years between each two, so as to exhibit the amount of change for each year, after the wine had been kept for the various periods:—

I.	II.	III.
0 ..(Made by myself).	0·22	
		0·2700
1½.....(1866).....	0·63	
		0·0700
2½.....(1865).....	0·70	
		0·0300
3½.....(1864).....	0·73	
		0·0200
4½.....(1863).....	0·75	
		0·0150
5½.....(1862).....	0·76½	
		0·0150
6½.....(1861).....	0·78	
		0·0070
9½.....(1858).....	0·80	
		0·0030
16½.....(1851).....	0·82	
		0·0020
20½.....(1847).....	0·83	
		0·0008
33½.....(1834).....	0·84	
		0·0007
47½.....(1820).....	0·85	

Since the above table does not refer to wines of even years of age, I subjoin below another derived from it by laying down the results on paper as a curve, and interpolating by careful measurements:—

I.	II.	III.
0.....	0·220	
		0·330
1.....	0·550	
		0·120
2.....	0·670	
		0·050
3.....	0·720	
		0·022
4.....	0·742	
		0·017
5.....	0·760	
		0·012
6.....	0·772	
		0·010
7.....	0·782	
		0·007
8.....	0·790	
		0·005
9.....	0·795	
		0·005
10.....	0·800	

It will thus be seen that the rate at which the B colour changes into C is far more rapid in the case of new wine, when much of it is present, than after the wine has become older; being, in fact, about ten times as rapid in the first year as in the third, and about 100 times as rapid as in the twentieth. On this account, the difference for each year is at first so considerable that wines of different vintages could easily be distinguished; but after about six years, the difference is so small that it would be difficult, or impossible, to determine the age to within a single year. After twenty years, a difference of even ten years does not show any striking contrast, and the age could not, therefore, be determined to nearer than ten years by this process. However, up to six years I think it quite possible to determine the age to within a single year. I took specimens of various ports from the casks, of different ages up to six or seven years, and labelled them in such a manner that I did not know the age of any, but could ascertain it afterwards by reference, I then made the experiments with great care, and found that, by proper attention to the details described above, I could correctly determine the year of vintage of each particular specimen.

As already mentioned, the change of the B colour into the C is most probably the effect of the oxygen of the air, which appears to act slowly through the wood of the cask; but the relative amount of these two colours is also modified by the deposit of crust. When kept in well-corked bottles, the change does not appear to be the same, and goes on far more slowly. I therefore think it would be scarcely possible to ascertain the length of time that the wine had been in bottles, and am inclined to believe that the amount of change observed on adding sulphite of soda corresponds more closely with the time that the wine had been previously kept in the cask. I have especially observed this in the case of Bordeaux and Burgundy wines. Those of this type which I have hitherto examined seem to contain a larger relative amount of the B colour, when a few years old, than ordinary ports, and in this respect agree with the so-called *natural port*; but the rate of change is greater when they are kept for some years, probably owing to their containing a less amount of alcohol. There is also a greater variation in different samples of the same age than I have met with in port wine, which is probably because the amount of alcohol in such wines varies more in proportion to the total quantity.

It appears, therefore, that the natural colour of dark grapes is changed by oxidisation into the somewhat similar colour found in new wines, and that, by still further oxidisation, this is converted into another entirely different colour, which becomes much paler by further oxidisation. The rate at which these changes take place varies according to circumstances, but, other things being equal, it varies according to the time of the action. Much also depends on the deposition of colour in the form of crust, and after a long time the original dark coloured substance is almost entirely lost, and only an amber colour remains in solution, which behaves with reagents precisely like that in sherry wines.

On White Wines.

The colouring matter of white wines appears to be derived from one of those yellow substances, soluble in water, of which there are several of materially different character in the faded leaves of different kinds of plants, as more fully described hereafter when treating on hops. That met with in the orange-coloured leaves of the beech is a good example. The depth of the colour is made nearly ten times as great by the addition of ammonia, and when dissolved in strong sulphuric acid diluted with an equal bulk of water, oxidising reagents first turn it much darker, and then much paler. When, however, kept for some months dissolved in dilute alcohol it turns to a much darker tint, and then the solution, with excess of ammonia, is only twice as dark

as when made acid by citric acid. Oxidising reagents added to the solution in sulphuric acid do not make the tint any deeper, and thus it appears as if it had been changed by oxidisation into an entirely different colour. The character of this change agrees with what occurs when the colour of dark grapes is oxidised, as already described; and both are good examples of what appears to be a general law. If not already oxidised, a certain amount of oxidisation causes the absorption to advance towards the red end of the spectrum to an extent varying according to the position of the original absorption, and then a still further oxidisation causes the absorption to recede from the red end to considerably beyond the original position, sometimes so much so that all colour is lost. We might thus say that such substances may occur in an unoxidised, in an oxidised, and in a per-oxidised condition. These and similar facts seem also to show that there is an intimate relation between the chemical changes and the particular rays of light absorbed by such substances; but the discussion of this very interesting question would lead me far away from the more immediate subject of this paper.

On comparing the colour of sherry wine with that produced by the action of the air on a solution in dilute alcohol of the substance in faded beech leaves soluble in water, I was unable to discover any difference, and hence I think we may conclude that it is formed by the oxidisation of the yellow colour of the grapes; but in some wines it is imperfectly oxidised, and they turn darker when exposed to the air.

Adulterations of Wine.

The only cases in which the spectrum method can be easily applied to detect adulterations in wines are when some colouring matter has been introduced to give a false appearance of age, or to bring the colour up to some desired standard. According to Payen's interesting work, * logwood and Brazil wood were at all events employed a few years ago for this purpose; and rhatany root and the berries of the so-called *Virginian Poke* (*Phytolacca decandra*) are sometimes used. I mention these because I purpose to briefly describe how they may be detected, as an illustration of the methods which may be employed in such investigations. I must, however, confess that I have not detected these substances in any wines of commerce that I have yet examined; but then I have had very little opportunity for studying those likely to contain them.

In order to detect logwood or Brazil wood, a small quantity of the wine should be agitated in a test-tube with an equal volume of ether, which rises to the surface in an almost colourless state if the wine be pure, but is tinged with a more or less strong yellow when either of the above-named substances is present. The ethereal solution should be transferred to a small evaporating dish by means of a pipette, and a fresh quantity of ether agitated with the wine, and added to the other. The most useful kind of pipette for this and similar purposes is one with a small vulcanised india-rubber top, so arranged that, after having been compressed, it may, by its own elastic force, draw up the liquid. After evaporating the solution to dryness, a small quantity of the colour should be dissolved in water in an experiment cell, and treated with bicarbonate of ammonia. In both cases this developes a single very distinct absorption band in the green, that characteristic of logwood being situated at $4\frac{3}{8}$ of my scale, whilst that of Brazil wood is farther from the red end, at $5\frac{1}{4}$; and the solution is strongly fluorescent, of a peculiar orange colour. These spectra are so characteristic, and can be so easily compared with those of the substances themselves, that an extremely minute quantity of either could be detected with certainty.

The colour of rhatany root does not give any well-marked band in an aqueous solution, either acid or alkaline; but when dissolved in alcohol and slightly acid, it shows a moderately distinct band between the yellow and green, at $3\frac{3}{4}$ of my scale, and a fainter at $7\frac{1}{4}$. In order to detect this substance the wine should, therefore, be evaporated to small bulk, and re-dissolved in strong alcohol, and after this has stood in a test-tube until the insoluble matter has been deposited and the solution has become quite clear, the absorption band at $3\frac{3}{4}$ may be more or less distinctly recognised, according to the amount of the rhatany root present; but the natural colour of the wine makes it impossible to detect a very small quantity.

The dark crimson berries of the Virginian poke are remarkable for containing a colour belonging to my group C; whereas those of nearly all fruits of that tint belong to group B. It shows two absorption bands, which are more distinct in an alcoholic than in an aqueous solution, and are $4\frac{5}{8}$, $7\frac{5}{8}$. To detect this substance we ought, therefore, to adopt the same process as in the case of rhatany root, and endeavour to see those bands, which might sometimes be made more distinct by adding a little water and sulphite of soda.

These substances may be changed by keeping long in solution, and therefore might not be detected in old wines.

On the Application of the Spectrum Microscope to the Chemistry of Beer.

In studying the colouring matters in beer, it is, in the first place, desirable to understand those met with in the various substances used in brewing; but it is unnecessary to take into consideration colours insoluble in water.

When malt is digested in hot water, an orange-yellow colouring matter is extracted; but the solution contains so much sugar and gum as to interfere with the necessary experiments. It should, therefore, be evaporated to the consistency of syrup, alcohol added by degrees, and the precipitated gum and sugar well stirred up, so that as much colouring matter as possible may be dissolved. After standing till quite clear, this solution, on evaporation, yields a pale orange-yellow syrup, which, when dissolved in water or alcohol, gives a spectrum without any decided characters. Ammonia makes it a deeper and brighter yellow; and the same change occurs when it is dissolved in sulphuric acid. In all these experiments, a mixture of equal volumes of the concentrated acid and water should be used; for, if much stronger, it chars vegetable substances, and, if weaker, it does not act well with the reagents added to it. When dissolved in this, the colour of malt is made much darker by the addition of nitric acid or chlorate of potash; but an excess of the latter makes it rapidly fade to a pale yellow, whilst hypochlorite of soda, in small quantity, makes it somewhat more orange, and more makes it a very pale yellow. The characteristic test is hypochlorite of soda, added to an aqueous or alcoholic solution in which a little citric acid has been dissolved. The addition of a suitable quantity of the hypochlorite turns the aqueous solution to a pink

* "Précis des Substances Alimentaires," note at p. 455.

flesh-colour, becoming deeper; but it is not clear, and, on standing, a copious pink flocculent deposit subsides. When seen to the greatest advantage, the spectrum is 4 . - - 8 . . 10 - - 11—, without any decided narrow absorption bands. If, however, the colour was dissolved in alcohol, the solution remains clear; there is a well-marked band at the yellow end of the green, which at first is 4½, and, as the colour becomes deeper, is more distinct, and rises to 5. The flesh-coloured deposit from the solution in water is easily dissolved by alcohol, and gives the same spectrum; and these facts are so unique that this colouring matter could be easily recognised in complicated mixtures. It certainly does not occur in barley, and must, therefore, be formed in the process of malting. Water extracts from barley a brown colour, insoluble in alcohol, which exactly corresponds with that of liquorice; and also a yellow colour, soluble in spirit, which does not exactly correspond with that obtained from hops, but yet differs from it in such a manner that, taking all the facts into consideration, it seems probable that it is the same colour in a less pure condition.

When hops are boiled in water, the solution evaporated, and the gum, &c., removed by alcohol, as already described, an orange-yellow colour is obtained which, in general appearance and in its behaviour with most reagents, is extremely similar to that from malt. It may, however, be easily distinguished by the action of hypochlorite of soda; for, when this is added to an aqueous solution previously treated with a little citric acid, it merely changes it to a very pale yellow, without any shade of pink. This colour, or, at least, colours, which I have not been able to distinguish from it, is met with in several kinds of faded leaves, stems, and roots, and seems to be very generally distributed.

When the partially-charred malt used in brewing porter is digested in water, a dark solution is obtained; and, on evaporation to small bulk and treatment with alcohol, nearly the whole of this dark colour is precipitated along with the gum. To obtain it more pure, it may be re-dissolved once or twice in a little water, and re-precipitated by alcohol. When dissolved in water, it gives an orange-brown solution, with a spectrum . . . 4 . . 5 - - 6—, made somewhat darker by ammonia; and, when dissolved in sulphuric acid, the colour and spectrum are nearly the same. Oxidising reagents do not make it any darker in either solvent, but merely cause it to fade to a pale yellow.

Besides this dark colour, highly-dried malt contains an orange-yellow, soluble in both strong alcohol and water. This differs from that obtained from pale malt, in not being turned at all pink by the action of hypochlorite of soda, and is distinguished from the colouring matter of hops or of beer (with which it agrees in general colour) by not being made at all darker by the addition of oxidising reagents to the solution in sulphuric acid, as if it were already in an oxidised condition.

Liquorice is chiefly coloured by a brown substance, which closely resembles that present in dark malt. When alcohol is added to the strong aqueous solution, it is precipitated in the same manner; and when dissolved in water the general colour is very similar, though rather more orange. They may, however, be easily distinguished by the action of oxidising reagents. If to solutions in sulphuric acid of equal depth of colour equal quantities of chlorate of potash be gradually added, the malt first becomes a much paler orange, and then pale yellow; whereas the liquorice turns to an orange, which does not become pale until very much more chlorate has been added than suffices to make the malt very pale. Though they can thus be easily distinguished, yet when mixed together, as in porter, it is not easy to obtain decided results. The change of colour is very similar in kind, and differs only in degree; so that the addition of too much chlorate may make the liquorice as pale an orange as the malt; and when not much liquorice occurs mixed with malt, it becomes very difficult to recognise it. Still, however, with care its presence may be detected in ordinary porter.

That colouring matter of porter which is soluble in strong alcohol behaves with reagents like a mixture of those from beer and dark malt. Hypochlorite of soda turns the solution in sulphuric acid to a red, but of a less deep tint than in the case of beer.

The sweet wort obtained in brewing contains the colour of malt, already described, and, after boiling with hops, the hop colour; but after fermentation a change is found to have occurred, which proceeds still further when the beer is kept in the barrel. This change is best shown by the addition of hypochlorite of soda to the solution of the colouring matter in sulphuric acid. The gum, &c., should be removed by means of alcohol, in the manner already named when describing malt. Taking two experiment cells, and dissolving in one the colour of the unfermented wort, and in the other an equal quantity of the colour of beer that has been kept some months in barrel, the general tint is seen to be very similar. Since the solutions are otherwise apt to be turbid, it is best to fill the tubes three-fourths with the sulphuric acid diluted with an equal bulk of water, and then to fill up with alcohol, after which the coloured syrup can be added on a platinum wire, and made to dissolve by stirring. On adding little by little hypochlorite of soda to such a solution of the unfermented wort, it first turns it a little more orange, and then pale yellow; whereas, in the case of the beer kept in barrel, it is first gradually changed to a deep pink-red, which, when strong, is 3 . - 4—, and when seen to the greatest advantage is 5 - - 7½ . . . 9½ - - 10—, having, therefore, a broad absorption band at 6½. On adding more hypochlorite it becomes more orange, and finally an orange-yellow. The fermented wort behaves in an intermediate manner; and hence it should appear that the change begins during fermentation, and is continued when the beer is kept in barrel. Still, however, it does not seem to depend simply on fermentation, since no such change occurs when fermented on a small scale; and, therefore, it may perhaps be due to deoxidisation, which would be more likely to take place in a large quantity less exposed to air.

If in any case it were desirable to ascertain whether or no any mixed liquid contained beer, the various reactions with the reagents already mentioned might enable us to form a very decided opinion when other tests failed; but so much would depend on the circumstances of the case that no general rule could be given.

On Some Adulterations of Malt Liquors.

I have made very many experiments in order to ascertain how far the spectrum method can be employed in detecting adulterations in beer. Many of the substances used are added in such quantities, and impart so little colour, that there seems to be no chance of discovering them by their spectra. I have chiefly directed my attention to those employed as substitutes for hops, such as picric acid, gentian root, calumba root, and the entire plant of *Ophelia chireta*, commonly known by the more

simple name of chiretta. So far I have not been able to detect any difference between the colouring matter of gentian, or chiretta, and hops. They all give the same reactions and spectra with the various reagents, or at least so nearly the same that there appears to be no chance of detecting them in the presence of the colouring matter of wort or beer. Calumba root, however, contains two colours, one of which is quite different from any that should occur in genuine malt liquors. The exterior part of the root is yellow, and water extracts from it a bright yellow colour. The interior part is browner, and does not contain this yellow, but a browner colour, which also occurs to some extent in the outer layer. On evaporating the aqueous solution to small bulk and re-dissolving in alcohol, this brown colour is left insoluble, but the bright yellow colour remains in the alcohol in a curiously turbid condition. The brown colour appears to be identical with that found in liquorice, and could not be detected by any of the reagents; but the yellow colour may be recognised, if beer has been adulterated by a moderate amount of calumba root. When dissolved in water or alcohol it is a very clear, bright yellow, but gives no well-defined spectrum. Ammonia makes it slightly orange, and when dissolved in sulphuric acid it is the same bright yellow as in water. Oxidising reagents, such as hypochlorite of soda, produce no change in weak acid solutions; but when added to the solution in sulphuric acid they alter it into a deep red colour, changed into an orange-yellow by excess. Deoxidising reagents, such as hyposulphite of soda, restore the deep red to the original yellow. The most useful test in connection with the various other colours already described is hypochlorite of soda gradually added to the solution in sulphuric acid. This first makes it a deep red, giving the spectrum 3 . . 4 - —, and the addition of a little more produces scarcely any further change; but when large excess has been added it fades to an orange, giving the spectrum 6 . - 7 —. The colouring matter of fresh wort treated in the same manner is not turned at all red, and though the colour of finished beer is changed to red in a very similar manner, yet, after so much hypochlorite has been added as to turn it deep pink-red, a very little more makes it pale yellow. We may take advantage of this circumstance to detect calumba root.

In examining any suspected beer, it, and a similar quantity of genuine, should be evaporated in separate dishes, so that the results may be more accurately compared. The presence of calumba root is first somewhat betrayed by the fact of the resin, which separates on evaporation, being abnormally yellow, and when the syrup is dissolved in alcohol, and the solution evaporated to dryness, the purified colour is decidedly brighter yellow than it ought to be. Taking, then, two experiment cells, so much of the colour of the genuine beer should be dissolved in one—in sulphuric acid—as to give a decided orange yellow, with a spectrum 5 . . 6 - - 7—; and in the other cell so much of the suspected material as to give a colour of about the same tint. In both cases, about one-fourth of the bulk of the liquid should be alcohol, so as to prevent the formation of any precipitate. Hypochlorite of soda should then be added very gradually, and in equal quantities to both, when at first both will change to red, having a pinker tint in the genuine. After so much has been added as to make both as dark as they can become, a little more will turn the genuine to a pale yellow, giving a spectrum 7 . . 8 - - 9 —; whereas that containing calumba root will remain a fine red orange, with a spectrum $3\frac{1}{2}$ . . $4\frac{1}{2}$ - - 5—. If too large a quantity of the hypochlorite be added, the colour of the calumba root will change into a much paler yellow, scarcely differing from that in the case of genuine beer, and hence particular care must be taken to add it gradually, and in small quantities. By this means, the adulteration of beer with 2 ozs. of calumba root to the gallon may be detected with confidence; but much less than that would scarcely give reliable results, unless it were possible to examine the unfermented wort. The addition of the hypochlorite to genuine wort does not turn it at all red, and merely alters it to a pale yellow; whereas, if calumba be present, it turns it to a decided red.

Picric acid may be detected when present in no larger quantity than 1 grain to a gallon. When dissolved in water, it is of a bright yellow colour, and cuts off the blue end of the spectrum in a sufficiently well-defined manner, giving the spectrum $8\frac{1}{2}$ . . . This is not changed by ammonia or citric acid, nor does hypochlorite of soda cause it to fade when added to an acid solution. The most striking change is that produced by the addition of sulphuric acid, which makes it so much paler that a couple of drops added to the aqueous solution in one of the small cells leaves it nearly colourless. In order to detect it in beer, about 1 oz. should be evaporated to dryness, and then re-dissolved in no more water than will make the solution sufficiently liquid to allow bubbles to rise readily through it. This should be introduced into a test-tube and agitated with ether, which dissolves out the greater part of the picric acid, but scarcely any colour, from genuine beer. Since it is very important to avoid contamination with any of the material not soluble in ether, it is well, in the first case, to use somewhat more than the bulk of the concentrated beer, and to transfer it to another *perfectly dry* test-tube, then agitate with a fresh quantity of ether and add it to the first, arranging so that the total amount of ether may fill a $\frac{1}{2}$ inch test-tube to the depth of about 2 inches. After corking it up, it should be allowed to stand till quite clear, and till any particles not soluble in ether have adhered to the sides of the tube. The clear solution should then be poured off into another tube, water added so as to give a depth of about half an inch, and well agitated with the ether. After it has collected at the bottom, the ether should be removed by a pipette, the aqueous solution washed with a little fresh ether, and then evaporated to dryness. In the case of genuine beer the ether extracts scarcely any colour, and the greater part of this and the resinous matter afterwards remain in the ether, so that on evaporating the aqueous solution, which is scarcely coloured, a mere trace of a yellow colour is obtained, so free from resin that, when dissolved in water and a drop or two of alcohol added, we obtain a clear, very pale yellow solution, so pale that if one ounce of beer has been used, the spectrum is about 10 . . 11.—, changed to about 9 . . 10 - - 11—by sulphuric acid. If, however, picric acid be present, the solution in ether is a decided clear bright yellow; the greater part of the colour is extracted from it by the water, and on evaporating to dryness more or less of a clear bright yellow is obtained. If as little as a grain per gallon were present, when dissolved in water with a drop of alcohol, a clear bright yellow solution would be obtained, giving the spectrum 8 . . . made much paler by the addition of sulphuric acid, which decolourises the picric acid, and merely shows the colour of the beer itself, which, if one ounce had been used, and all the product introduced into the experiment cell, would not be deeper than 9 . . 10 - - 11—, or very decidedly paler than what would be seen before the addition of sulphuric acid, if even less picric acid than one grain per gallon had been present in the beer.

I have not been able to discover any essential difference between the colouring matter of *Cocculus Indicus* and that

of liquorice; and though it would be difficult to prove it in a positive manner, yet I think it very probable that a small quantity of this colouring matter is the cause of the brown colour of chiretta, and of the slighly brown tinge in hops. It would, therefore, be impossible to detect *Cocculus Indicus* in porter by means of its colouring matter, even if present in far larger amount than is ever likely to be the case.

Though the detection of turmeric in beer does not necessarily depend upon the spectrum microscope, yet the method employed is so closely related to our present subject that it may be well to describe it. The best test for its presence is the very strongly fluorescent character of the solution in benzol. The alcoholic solution is much less fluorescent. In order to be able to detect fluorescence and examine the spectrum of the dispersed light, I have found it very convenient to make use of cells about three-quarters of an inch deep, made out of moderately thick barometer tube, having an internal diameter of about one-sixth of an inch, cut square, and polished at one end, and melted up at the other, which is fixed into a small brass foot by means of black sealing-wax. On introducing a clear solution, covering it with a small piece of thin glass, illuminating the tube at the side by strong daylight, and looking down the axis, the liquid appears quite black, if it be not at all fluorescent, for no light is reflected from either the apparatus or the liquid; whereas, if fluorescent, it looks more or less opaque and of a colour depending on the nature of the substance. Such tubes can easily be placed on the stage of the microscope, and the spectrum observed, which, in some instances, is remarkable in showing one or more narrow bright bands.

In the case of turmeric, a very minute quantity dissolved in benzol gives a beautiful more or less blue-green fluorescence, with no special dark or bright bands. Half an ounce of the suspected beer should be evaporated to so small a bulk that it may occupy only about half an inch in the depth of a test-tube half an inch in diameter, and an equal amount of benzol added to it, with about an equal quantity of alcohol; since, without this last, the globules of benzol collect together with extreme slowness. After well agitating the whole, the tube should be set aside until the benzol has collected at the top, as a clear solution, which must then be introduced into one of the cells just described, by means of a pipette. In the case of pure beer, this solution is of a faint yellow colour, but is scarcely at all fluorescent. If no more than one grain of turmeric has been added to a gallon of beer, the fluorescence is so strong that it could not be seen to greater advantage, and even as little as one-tenth of a grain per gallon may be detected with confidence.

It will thus be seen that the spectrum method of study serves to throw considerable light on some of the changes that take place in the process of brewing, and would also enable us to detect the presence of some adulterations; but, at the same time, it would always be requisite to bear in mind that it is possible that some of the colouring matters I have described may themselves become altered when kept in solution for a considerable time.

Adulteration in Drugs, &c.—Mustard.

I now proceed to describe the detection of adulteration in a variety of substances. Having just explained the method to be employed when the presence of turmeric is suspected, it may perhaps be well to mention now all that need be said on that substance. Its presence may easily be detected in nearly all the ground mustard sold in the shops; and, as far as I am able to judge from the intensity of the fluorescence, the amount varies from about one-third to one-half per cent.

The natural seeds contain a yellow colour soluble in water, which is the same as that found in many yellow leaves; another yellow colour, insoluble in water, but soluble in alcohol, which corresponds with the xanthophyll of yellow leaves; and there is also often present a small quantity of chlorophyll in the imperfectly ripe seeds. The powdered mustard should be digested in alcohol, about an equal quantity of water added, and the solution filtered. On agitating with benzol this rises to the top, with the colour of the turmeric in solution, which can be easily detected by its strong green fluorescence. Chlorophyll, if present, would give a red fluorescence, and by transmitted light, a spectrum with well-marked absorption bands.

Rhubarb.

The same process may be successfully employed in the case of rhubarb; and as small a quantity of turmeric as 1-10th per cent may be detected in no more than 2½ grains of rhubarb. There is not the least difficulty in distinguishing, by this means, inferior pale rhubarbs coloured by turmeric, so as to resemble those of the best quality.

The detection of small quantities of gamboge, added to increase the purgative action of these inferior kinds, is not so easy, and requires some care, especially in the presence of turmeric. The suspected powder should be placed on a small filter, and so little alcohol added as will give a few drops of clear solution, which would contain a comparatively large amount of the very soluble gamboge, and but little of the less soluble colour of the rhubarb itself. This alcoholic solution should then be agitated with bisulphide of carbon, and the supernatant alcoholic solution removed by means of a pipette and blotting-paper, and the solution in the bisulphide evaporated to dryness. This would contain a colour peculiar to the different kinds of rhubarb, and, perhaps, also turmeric and gamboge. If a small quantity dissolved in benzol gives the green fluorescent solution, turmeric is present; and, in order to detect the gamboge, it would then be requisite to re-dissolve in alcohol and add a little nitric acid, which so changes the colour of the turmeric that it is no longer removed by agitating with bisulphide of carbon; whilst the gamboge remains unchanged, and is abstracted by it from the alcoholic solution. After separating this, evaporating the bisulphide to dryness, and re-dissolving in alcohol, a small quantity of an alcoholic solution of iodine should be added, and then excess of ammonia, a little sulphite of soda, and a drop of water, to make it dissolve. This ensures the complete removal of any free iodine that may remain after the addition of ammonia.

In the case of pure rhubarb, this solution when sufficiently but not too strong, has a decided pink colour, giving no well-marked absorption band in any part of the spectrum, but transmitting the blue rays very considerably better than the green; whereas, when gamboge is present to the extent of 2 per cent or upwards, the yellow colour due to it cuts off the blue light, and the solution is orange colour. The spectra are as follows:—

Pure rhubarb	4 ... 8	9..10--11—
Rhubarb, with 2 per cent of gamboge	4 ... 9	-- 10—
" " 4 "	4 ... 8	-- 9—
Gamboge alone	7 ... 8	-- 9—

In very many other cases, bisulphide of carbon is a most valuable reagent to separate different colours. An

excess should be agitated with the alcoholic solution, when it sinks to the bottom, carrying with it the whole of some colours, and leaving the alcohol quite colourless. Other colours are only partially removed; whilst others are not abstracted in the least degree. These last are usually, but not always, those soluble in water; whereas, those easily removed are usually, if not always, insoluble in the liquid.

The cells for the examination of the spectra of solutions in bisulphide of carbon, ether, chloroform, or benzol, should be fixed to the glass plate by means of a mixture of glue and honey, made so as to be quite stiff, but yet to melt when warmed. Cells so cemented must be washed out with the liquids named above, and never with water or hydrous alcohol. The spectra of colours dissolved in the bisulphide are far more characteristic than when dissolved in any other liquid. So far I have met with between two and three dozen different vegetable colours soluble in this reagent. The absorption bands are much farther removed from the blue end, when they occur in that part, so as to be far more distinct; and their position is not subject to variation from any change produced by evaporation, as in the case of ordinary alcohol, which may thus become more weak, and give the bands in a very different situation.

On the whole, the spectra are so characteristic and uniform that different colours, soluble in bisulphide of carbon, may usually be recognised in a very satisfactory manner by means of the spectrum of that solution alone; and this is fortunate, since such colours can seldom be distinguished by their behaviour with reagents. The dried colour must be dissolved in fresh bisulphide, since, when it separates from the alcohol, it contains some of that liquid in solution, which alters the position of the bands. As an illustration of what may be done, I give a few examples:—

Cheese.

Cheese of orange colour was digested in bisulphide of carbon, the solution washed by agitating with alcohol, and evaporated to dryness. On re-dissolving in alcohol diluted with a little water, a considerable amount of oily matter was separated; and, after evaporating the clear solution to dryness, and re-dissolving in bisulphide of carbon, it gave the spectrum $\underline{5\frac{3}{8}\ 7\frac{1}{2}}$, which corresponds exactly with that of red annatto.

In all such experiments, it is requisite to use deep experiment cells (I use one $2\frac{1}{2}$ inches deep), so that the amount of the bisulphide may be large in comparison with that of the oils, since the presence of much oil causes the bands to lie nearer the blue end, and thus interferes with the production of the characteristic spectrum.

Butter.

Treating yellow butter in a somewhat similar manner, I obtained the spectrum $6\ 7\frac{1}{4}$. This differs entirely from that in the case of cheese, and corresponds with the spectrum of the colour of the exterior orange portion of carrots; but I am not quite certain whether this might not be derived from carrots eaten by the cows, though I am more strongly inclined to believe that it had been artificially introduced to increase the colour of the butter.

The difference between the spectra of the above-named colours and of various others closely allied to them will be better understood from the following table. In all cases they are those of the solutions in pure bisulphide of carbon:—

Red annatto	$\underline{5\frac{3}{8}}$	$\underline{7\frac{1}{2}}$	
Exterior of carrot and the skins of several kinds of fruit	6	$7\frac{1}{2}$	
Xanthophyll of many yellow leaves and flowers, and of the interior of carrots	$6\frac{1}{2}$	8	
Colour of the petals of *Brassica* and of many other yellow flowers	$\underline{6\frac{7}{4}}$	$\underline{8\frac{3}{8}}$	
Orange yellow-colour of turnip roots, and of the flowers of *Eryssimum Perofskianum*	$\underline{5\frac{1}{8}}$	$\underline{6\frac{3}{4}}$	$8\frac{3}{8}$

It will thus be seen that these spectra differ from one another so much as clearly to show that they are due to different substances, which are often further distinguished by their different behaviour with bisulphide of carbon and alcohol, some being almost entirely, and others only very partially removed from the alcoholic solution by that reagent, so that they may be separated when two occur mixed, as is not uncommon in some leaves and flowers. By first agitating the alcoholic solution with a little bisulphide, and washing this with alcohol, one may be procured nearly pure; and then, after agitating with a second small quantity of bisulphide and removing it, the other colour may be obtained nearly pure by evaporating the alcoholic solution to dryness, and dissolving the residue in bisulphide, which leaves indissoluble any of those numerous colours soluble in water which so commonly occur in leaves, flowers, and fruits. It is now nearly two years since I determined the existence of a considerable number of distinct substances, of which at least eight have lately been described by Dr. Thudichum,* under the general name of *leuteine*. I think that this new name can only be looked upon as something like the old term *xanthophyll*, as hitherto inaccurately employed for a whole series of yellow colours, some of which correspond with some of those included under *leuteine*. If it were, thought desirable to have a generic name, the term *leuteine* might indeed be employed; but I must protest against the idea that the substances described as such by Dr. Thudichum are one single colouring matter. Some of their properties are indeed very similar, but that is often the case with those substances which give closely connected spectra, even when other facts show that they are entirely distinct, for there seems to be a sort of correlation between optical characters and chemical reactions; but this is no reason why we should confound together substances giving absorption-bands in distinctly different positions in similar solutions.

Saffron.

The adulteration of saffron with the sliced petals of the yellow crocus could easily be detected, even in a solution, by means of the remarkable spectrum of the latter, when the product of the action of bromine is deoxidised by sulphite or hyposulphite of soda. To the alcoholic solution of the colours soluble in water an aqueous solution of bromine should be added very gradually, until, after having become quite pale, it is made slightly yellow by the addition of more. Excess of ammonia and a little sulphite of soda should then be added. In the case of pure saffron the liquid remains almost or quite colourless, whereas ammonia first turns the colouring matter of the crocus to a red, which soon becomes yellow, and then sulphite of soda changes it to a remarkably fine red, which is highly fluorescent or red-orange colour, the spectrum showing a bright narrow band at about $3\frac{1}{4}$. That of the transmitted light is very characteristic, and shows an excellent absorption band at $4\frac{5}{8}$. On adding citric acid

* *Proceedings of the Royal Society*, vol. xvii., p. 253, January, 1869.

the colour becomes red-pink; it is still highly fluorescent, but of more yellow tint than before, the bright band being raised to about 4, and the absorption band in the spectrum of the transmitted light is raised to $5\frac{1}{2}$: but the addition of hydrochloric acid destroys both the fluorescence and the absorption band. The only colour that I have met with analogous to this is one which occurs in the yellow flowers of several plants allied to the common wallflower (*Cherianthus Cheiri*), but the bands are in distinctly different positions. The production of the fluorescent colour is apparently due in both cases to deoxidisation, for even proto-sulphate of iron has the same effect as sulphite or hyphosulphite of soda. If too much bromine be added, this change does not take place; but by a little care a small amount of the petals of the yellow crocus could be detected in a considerable quantity of saffron. The presence of safflower might be recognised by a similar process, but not so decidedly. After adding bromine and ammonia, it remains distinctly yellow, but gives no absorption band, whereas pure saffron is thereby quite decolourised.

Aloes.

I have tried a number of experiments in order to ascertain whether it would be possible to detect the adulteration of the socotrine aloes with the hæpatic, but have not yet succeeded in discovering any satisfactory method. It appears as if both contain the same general colouring matter, but the socotrine a second in addition. When ammonia is added to the alcoholic solutions, the socotrine gives a more orange colour than the hæpatic, and the green part of the spectrum is more absorbed; so that, when compared side by side, the spectra are—

Socotrine..... 4 .. $6\frac{1}{2}$ – –
Hæpatic..... $6\frac{3}{4}$ – –

It would, therefore, be possible to distinguish them from one another, or to detect the socotrine in the hæpatic, which is, however the reverse of what would be likely to occur, since inferior things are not often adulterated with better.

Adulterations by means of Cochineal and Magenta.

Cochineal may be best detected in the tincture of roses by adding to the aqueous solution bicarbonate of ammonia and sulphite of soda. This changes the colour of the pure tincture to a very pale yellow, but that adulterated with cochineal to a light red. The spectra are somewhat thus:—

Pure tincture..... 8 .. 9 – – 10 –
Adulterated with cochineal.... $3\frac{1}{4}$.. 7 – – 9 –

The presence of magenta might be recognised by the spectrum of the solution in its natural state. The pure tincture shows no narrow absorption band in the green, whereas magenta gives a very distinct one, situated at 5 of my scale. In the case of the syrup of damsons and similar fruits, magenta may be detected, when in very small quantity, by agitating a dilute alcoholic solution with chloroform. If so much alcohol be added as only to partially dissolve the chloroform, scarcely a trace of the magenta is left in the alcoholic solution; and the characteristic spectrum can be easily seen by examining the chloroform, which scarcely abstracts any other colour. Ammonia produces no change in a solution of magenta in dilute alcohol; but the absorption band is immediately removed by a mere trace of sulphite of soda.

It would scarcely be a correct description of the facts to say that cochineal may easily be *detected* in pink-coloured confectionery, since, in some cases, its spectrum is seen to almost as great advantage as in any condition without any preparation, and it could generally be recognised with very little manipulation.

No doubt many other applications of methods similar to those I have described would present themselves to any one engaged in technical inquiries. I do not for one moment pretend to have exhausted the subject. I have merely examined various questions in order ascertain what methods might be employed with advantage; and I trust that the cases described above will, at all events, facilitate the application of this kind of qualitative analysis to practical questions; for I have met with many who were anxious to employ it, but had not sufficient time at command to make the preliminary experiments, which are so very necessary in all such inquiries.

NOTE ON THE AMERICAN ECLIPSE.

Dr. Morton, Professor of Chemistry in the University of Pennsylvania, has kindly forwarded me photographs of the phenomena of totality. By combining in the stereoscope pairs of these, separated by intervals of about half a minute of time, the black globe of the moon appears projected far in front of the luminous prominences and the corona, which are, therefore, clearly seen to belong to the sun. Glass transparencies from negatives specially selected for this purpose, and appropriately mounted, would show these phenomena in a very striking manner.

William Crookes.

ELECTRICITY IN PLANTS.

BY EDWIN SMITH, M.A.

There is a very interesting chapter in Becquerel's smaller treatise (in three volumes) on "Electricity and Magnetism" concerning the electrical phenomena of plants. I was induced, by reading this chapter, to make a series of experiments, with a view to illustrate the author's statements, and, if possible, to throw some fresh light upon an obscure and puzzling subject. I am now going to put together some notes of these experiments, carefully made at the time, in the hope that they may not be without a certain interest to others. The galvanometer employed is a home-made one, but tolerably sensitive. My greatest difficulty has been to depolarise the slips of platinum by means of which I have made the voltaic circuits; but every care has been taken, to the best of my ability, to obviate error arising from this cause, as well as from thermo-electric disturbance.

Experiment 1.—Take the thick, juicy leaf-stalk of the common garden rhubarb, and, having cut off a length of from 4 to 18 inches, apply a square of platinum foil to each end of the piece. Connect, by means of platinum wire, these two plates with opposite terminals of the galvanometer. The needle will be powerfully deflected. Now reverse the position of the rhubarb between its platinum surfaces, connect as before, and the needle will again be deflected, but in an opposite direction. Having previously ascertained how to interpret the movements of the needle, by noticing its behaviour when a voltaic current is produced between zinc and diluted acid, with platinum for negative plate, and transmitted through the coil, you will at once conclude that a current of electricity is passing from that end of the leaf-stalk nearest the root towards the opposite end, nearest the blade of the leaf.

Experiment 2.—Cut off a piece about 3 inches long

from the thickest part of the same leaf-stalk. Divide it longitudinally down the middle. Pare off a level slice of the outer cuticle. Lay the platinum slips close to the two flat sides thus provided, and connect with the galvanometer. There will be indicated a current from the outer side nearest the cuticle to the inner axis of the leaf-stalk. If the section is made thinner, there will be a current in the same direction. You may confirm your conclusion, as before, by simply turning over the piece of rhubarb, so as to reverse the current. Experiments 1 and 2 may be tried upon a thick midrib or branch of the same, taken from the leaf-blade, with a precisely similar result. A cucumber acts in the same way.

Experiment 3.—Insert a platinum wire into the lower end of the flower-stalk of peony. Apply foil to one of the large bracts, or to a petal; connect, and observe deflection. A current is detected flowing from the lower end of the flower-stalk to the bract or petal. The same experiment may be tried with a sprig of fresh oak-leaves, or bramble, or chickweed, or bunch of elder-buds, or poppy-flower, or stalk and leaves of poppy. The current always sets from the point nearest to the root towards the organs furthest from the root. If wires be inserted in the pistil of a flower and its stalk, there will be shown a current flowing towards the former.

Experiment 4.—Lay a leaf of the common dock between pieces of platinum foil. Connect the different surfaces with opposite terminals of the galvanometer, and notice the deflection. A current is indicated from the upper to the under surface of the leaf. A leaf of Spanish chestnut or of young elder will give the same result; but, in four experiments on a leaf of sycamore, I got a current from the under to the upper surface, after a momentary current in an opposite direction. I infer, however, that the momentary current was the true one, and that the second arose from polarisation; for I obtained this latter current by merely employing filter-paper dipped in distilled water, and laid between the slips of foil.

Experiment 5.—Twist a piece of wire round the outer cuticle of a young twig of hawthorn. Insert a second wire between the bark and wood, so as to touch the layer of cambium. On completing the circuit, a current will be indicated from the cambium to the outer cuticle. Again: pass a wire into the pith, and a current may be detected taking a direction from the cambium to the pith. Instead of hawthorn, a cutting from a fresh branch of elder, laurel, hedge-mustard, thistle, groundsel, yarrow, or other dicotyledonous plant, may be employed, with, as I have uniformly found, the same effect.

Experiment 6.—Scrape off the outer cuticle of the root of cress. By means of wires, as before, test the direction of the electric currents. They will be found to flow from the outside to the axis of the root, and, again, from the root-stock, or point of junction with the stem, towards the lower tapering end. The same effects are exhibited by the root of cat's-ear, or of thistle. If plates of platinum foil are applied to the flat surfaces made by cutting across the thick and thin ends of a carrot, a current will be found to set from the thick end of this root to the smaller end.

Experiment 7.—Take a bunch of the seeds of sycamore. Dip a samara attached to the stalk near its broader end into one of the mercury-cups, and a samara attached to the stalk at a point nearer the smaller end into the other cup. A current is indicated from the former towards the latter, in strict analogy to what happened in the third experiment. Or a piece of the stalk itself may be bent, and its ends dipped into the mercury-cups. A current will be indicated, having the same direction as before. A cutting from any pliable stem may be tried in this way, and always, so far as my experience goes, with a similar result.

Experiment 8.—Pass a platinum wire through the tubular hollow of a stem of *Poa*, or some other meadow-grass. Twist another platinum wire round the outside, and connect both with the galvanometer. A current will be shown, having a direction from the interior to the exterior surface of the stem in question. Such appears to be the law with the stems of monocotyledonous plants.

Experiment 9.—Make two cuts through a raw potato, one through the centre, another near the outer coat. Apply strips of platinum to the two flat surfaces, and connect with opposite terminals of the galvanometer. A current is shown to be passing from the centre towards the outside. A lemon, treated in the same way, furnished a current from the outside towards the centre. With a turnip, a gooseberry, and a pear, the same result was obtained; but a stalk of asparagus followed the law of the potato. A boiled potato, tested, when cold, by the same method, gave a current from the outside towards the centre, the indication being confirmed by a reversal of the slice between the platinum conductors. But, after moistening a fresh piece of boiled potato with distilled water, a current was obtained from the centre towards the outside—a result confirmed by reversing the position of the slice between the platinum conductors, as in the previous trial. Fresh platinum was employed, to obviate, as far as possible, any error from polarisation.

Experiment 10.—Reduce to a pulp with distilled water some of the meal nearest the coat of a baked potato. Then make a similar pulp of some of the meal at the centre. Having placed a plug of tow at the bend of a U-tube, pour the pulps thus prepared into different limbs. Connect, by slips and wires of platinum, with the galvanometer. In my experiment, a current was indicated from the outer pulp towards the inner pulp, agreeably to the result of my first experiment with a slice of boiled potato. My object was to destroy all vitality in the tuber by boiling or baking, and to see whether any chemical action might still remain—sufficient to cause a voltaic current when meal from different parts of the potato was made to furnish a voltaic couple.

Experiment 11.—Having procured a garden nasturtium growing in a flower-pot, insert a wire in the fleshy stem, a few inches above the soil. Then thrust a second wire through the small hole at the bottom of the pot into the soil. Connect with galvanometer. The needle is so deflected as to indicate the passing of a current from the plant to the soil in which it grows. Watering the soil made no change in the direction of the current when I performed the experiment. I also stuck the first wire into the stem in various ways and in various parts, always with the same results. At the same time, a current was detected passing from the root end towards the leaf end of the stem, conformably to the rule in other cases.

Experiment 12.—Make a solution of oxygen in distilled water, also a solution of carbonic acid. Pour them into the different limbs of a U-tube furnished with a plug of tow. Insert platinum slips, and connect with galvanometer. There will be a marked deflection of the needle, showing the passage of an electric current from the oxygen to the carbonic acid.

[English Edition, Vol. XX., No. 525, pages 289, 290.]

Confirm the result by reversing the platinum connectors.

The foregoing series of experiments are enough to set one thinking; but I feel that it would be premature to reason upon them at present, even with the admirable clue afforded by the treatise of M. Becquerel. I should like to compare, for instance, the electrical phenomena of plants in spring and in autumn, to see how far they are affected by the condition and flow of the sap.* In a future paper, I may, perhaps, be permitted to return to the subject, and attempt some *rationale* of the curious order of facts above described.

ON THE

ESTIMATION OF IODINE AND BROMINE,

WITH SPECIAL REFERENCE TO THE

ANALYSIS OF KELP.†

BY R. R. TATLOCK, F.C.S.

The methods for the estimation of iodine and bromine in presence of chlorine that have been devised from time to time are exceedingly numerous, but, in many cases, very unsatisfactory. They generally require either extreme skill and nicety on the part of the operator (a very small error in the manipulation seriously affecting the results), or they are so tedious and inapplicable in most ordinary circumstances as to be of little value. These remarks apply specially to methods that have been described for the estimation of iodine in kelp, in which the presence of bromine is either overlooked or ignored, although its existence would render such methods totally inapplicable.

The object of the following note is to describe a method for the determination of iodine, bromine, and chlorine, in presence of each other, which I have followed for many years, and which has been perfectly successful in the analysis of kelp. It is not intended to supersede other methods, but merely to take its place along with them, its simplicity in the hands of indifferently-skilled chemists rendering it suitable for adoption in the manufacturer's laboratory, a quality which will be valued more particularly in Glasgow—the seat of the iodine manufacture; while, in point of accuracy, it leaves nothing to be desired.

The method, like that of Frederick Field (*Chemical Gazette* for 1857, No. 357), is based upon the wide difference between the equivalents of iodine, bromine, and chlorine; but the mode of procedure is totally different from that of Field, and is not open to an objection which Fresenius has taken to that gentleman's process of determining these three elements. It depends upon the displacement of iodine by bromine, and of iodine and bromine by chlorine. I shall proceed to give the method in detail before referring to its application in the analysis of kelp.

1. The solution containing the iodide, bromide, and chloride, preferably in combination with an alkali metal, is divided into three equal portions, or, at any rate, three equal portions of it are drawn off. To the one, solution of silver nitrate is added in excess, to precipitate the whole of the I, Br, and Cl. The fluid is then feebly acidified with pure nitric acid, warmed, and agitated till the precipitate settles. This is collected on a small weighed filter, washed with hot water, dried as far as possible at 212°, removed from the filter, dried perfectly by heating to incipient fusion, and weighed, the weight of the small portion adhering to the filter being added, and the weight of the whole noted as—

$$AgI + AgBr + AgCl.$$

2. Another portion of the solution is transferred to a small basin, and a quantity of pure bromine-water added. The mixture is then carefully evaporated on an open water-bath, more bromine-water being added from time to time, till the escaping vapours no longer turn starch-paper blue on a fresh addition—showing that all the liberated iodine has escaped. To ensure excess, a little more aqua-bromine is added, and the solution evaporated to complete dryness. The dry residue is then drenched with water, and the result heated till again dry: this operation is repeated two or three times, to ensure the complete expulsion of any hydrobromic acid that may have been present in the bromine-water. The residue, which now consists solely of alkaline bromide and chloride, is dissolved in water, silver nitrate added in excess, the solution acidified, and the precipitate collected and weighed in the usual way. It is noted as $AgBr + AgBr + AgCl$.

3. The last portion of the solution is brought into a small basin, and a quantity of strong chlorine-water added, to effect the liberation of the iodine and bromine. The mixture is then evaporated till all colour is gone, and some more chlorine-water added. If the solution remains colourless, the whole of the iodine and bromine has been expelled, and the alkali metal will exist entirely as chloride. The solution is then brought completely to dryness, after which it is evaporated with a few drops of water two or three times, to expel any hydrochloric or hydrobromic acid. The dry residue is dissolved in water, the solution acidified with pure nitric acid, silver nitrate added in excess as before, and the chloride of silver collected as usual. Its weight is noted as—

$$AgCl + AgCl + AgCl.$$

It is obvious that we have now data from which we can calculate the amounts of iodine, bromine, and chlorine present; for, as the equivalent of bromine is less than that of iodine, in the proportion of 80 to 127, the second precipitate, in which the iodine is replaced by bromine, must weigh proportionately less than the first; and, as the equivalent of chlorine is less than that of either iodine or bromine, in the ratio of 35·5 to 127 in the one case, and 80 in the other, the last precipitate must weigh still less than the second, and we can thus, from the observed differences, deduce the exact quantities of the three elements present.

Example:—

1. $AgI + AgBr + AgCl$	weighed	15·57
2. $AgBr + AgBr + AgCl$	"	14·69
3. $AgCl + AgCl + AgCl$	"	12·20

Then—

I.		II.		Observed difference.
15·57	—	14·69	=	0·88

Loss for 1 equiv. I.		Observed loss.		1 equiv. I.		I present.
47	:	0·88	: :	127	:	2·378

I.		III.		Observed difference.
15·57	—	12·20	=	3·37

But, as a portion of this loss is caused by the replacement of iodine by chlorine, namely,

Equiv. of I.		Loss in replacing 1 equiv. I by Cl.		I found.		Loss accounted for by I present.
127	:	91·5	: :	2·378	:	1·713

* My experiments were most of them performed last spring.

† Read before the Glasgow Philosophical Society (Chemical Section), December 6th, 1869.

Observed loss.		Loss accounted for by I present.		Difference for Br.
3·37	—	1·713	=	1·657

Loss for 1 equiv. Br.		Observed loss on account of Br.		1 equiv. Br.		Br. found.
44·5	:	1·657	: :	80	:	2·978

Then, as the proportion of iodine and bromine are already known, it will be an easy matter to calculate them to iodide and bromide of silver, and deduct their weight from precipitate I, calculating the remainder (chloride of silver) to chlorine thus :—

I.		Ag I.		I present.		Ag I.
127	:	235	: :	2·378	:	4·400

And—

Br.		AgBr.		Br. present.		AgBr.
80	:	188	: :	2·978	:	6·998

Then—

AgI	4·400
AgBr	6·998
	11·398

Then—

$$15·57 - 11·398 = 4·172$$

Then—

AgCl.		Cl.		AgCl.		Cl.
143·5	:	35·5	: :	4·172	:	1·032

We had, therefore, present in the solution—

Iodine	2·378
Bromine	2·978
Chlorine	1·032

The bromine water may be easily obtained free from chlorine by distilling bromide of potassium in solution with less potassium dichromate than is necessary to expel the whole of the bromine, using, of course, a little hydrochloric acid.

We now come to the application of the above method to the analysis of kelp.

It is quite obvious that this process cannot be directly applied to substances containing I, Br, and Cl, in very different proportions, and consequently it cannot be used for the estimation of these elements in kelp immediately. The following method of treatment will be found to equalise as nearly as necessary the proportions of the three :—

2000 grs. of the kelp are digested in hot water, the solution allowed to settle, and the clear liquor filtered. The residue is boiled two or three times with water, the fluid being filtered in each case, and the residue finally brought on a filter and washed with boiling water. The filtrates and washings are neutralised as nearly as possible with hydrochloric acid, and chlorine gas passed into the solution till the latter becomes of a distinct orange colour, due to the liberation of iodine and bromine.

The fluid is then shaken up with about one-fourth of its bulk of carbonic sulphide, which takes up the liberated iodine and bromine, and carries them in solution to the bottom of the vessel, provided the specific gravity of the kelp solution be not higher than that of the carbonic sulphide. When this is not the case, the solution of kelp may be diluted till the carbonic sulphide sinks.

The bottom fluid, containing the iodine and bromine, is then drawn off by a fine syphon, and shaken up with an equal volume of water and some zinc-filings. The solut on is soon decolourised, on account of the formation of zinc iodide and zinc bromide, which pass into the water; and we have thus a watery solution of the two latter salts above, and colourless carbonic sulphide at the bottom. The latter is drawn off by a syphon, and restored to the kelp solution, to which some more chlorine-water is added; and, if a further quantity of iodine and bromine be liberated, the above operations are repeated till the liquor is quite exhausted.

It only now remains to evaporate the solution of zinc salts, divide into three equal portions, and determine I, Br, and Cl as before described.

With regard to the accuracy of the above method, it may be stated that two sets of trials on pure salts gave the following results, 5 grs. of each of the compounds being used in each case :—

Five grs. KI, 5 grs. KBr, and 5 grs. KCl gave—

	grains.
KI	4·97
KBr	4·97
KCl	5·08

Another trial, with the same quantities, gave—

KI	4·96
KBr	4·95
KCl	5·09

These results leave little doubt that the process is accurate and trustworthy, although I do not deny that other experiments are required to establish the method.

ON THE

CONSTITUTION OF THE COMPOUNDS OF SODIUM.

BY J. ALFRED WANKLYN, F.C.S.

Some degree of astonishment was expressed when, having discovered that ethylate of sodium and acetic ether give alcohol and an isomer of butyrate of soda, exhibiting a cleavage into alcohol and acetic acid, I did not follow the usual practice of regarding sodium as monatomic, but formulated the new compound as containing a triatomic metal. One of my chemical friends, who appeared to be unable to contain himself, pointed out to the Chemical Society of Berlin that my new compounds could be represented in the ordinary way, and, in accordance with this notion, formulated them as compounds of sodinated-ethyl, wherein the metal, regarded as monatomic, had replaced an equivalent of the hydrogen which, in union with carbon, constituted ethyl in the original compound.

I will, on the present occasion, adduce a reason which will be regarded as decisive against the ordinary formula. If the new compound were really a salt of sodinated-ethyl, it should admit of the replacement of its sodium by ethyl, and, as the result of such an operation, should give acetate of ethylated-ethyl (*i.e.* acetate of butyl). Now, nothing of the sort takes place. Iodide of ethyl, which is the proper reagent for effecting such replacements, does not produce iodide of sodium and acetate of butyl when it is made to act on my new isomer of butyrate of soda. Neither does the "absolute ethylate of sodium" (which my Berlin friend would write as hydrate of sodinated-ethyl) produce butylic alcohol by a similar treatment. The absence of such transformations and the actual course taken by the action of the iodide of ethyl on these substances, are, to my mind, conclusive against the formulæ which my chemical friends wanted me to assign to the new isomers of the sodium salts of the fatty acids.

Furthermore, I am unacquainted with any really cogent reason for assigning to sodium a mono-valent

function, even in the common, every-day sodium compounds. As yet, no vapour density determination has been made of any compound of sodium. Some nine or ten years ago, in a paper urging the di-valent nature of zinc and mercury, I pointed out that no metallic chloride, or other metallic compound, had been shown to present only one atom of chlorine or other representative of hydrogen in the standard, two volumes constituting the vapour-unit to which vapour densities are referred. The same remark holds good to-day; and, most probably, when chemists have taken the vapour density of common salt, there will be found two atoms of chlorine in the vapour unit.

The facts of the evolution of hydrogen when sodium acts upon water, of double decompositions taking place between salts of sodium and salts of other metals, are not more in accordance with the view that the metal is mono-valent than with other views.

On the other hand, the researches in which I have been engaged have constantly exhibited the polyvalency of sodium. I do not know any chemical compound which shows a greater tendency to enter into double compounds than does absolute ethylate of sodium. With HCl, C_2H_5OCl, H_2S, and C_2H_6O, it forms double compounds. With CO_2, it combines, forming a double compound. With NH_3 and CO, there is no action at all, even at 200° C.—neither combination nor reaction to yield separated products. Iodide of ethyl alone (and even this is a doubtful point) may possibly react without preliminary formation of a double compound.

Now, this constant tendency to form doubles is the criterion of polyvalency. Oxygen was regarded as divalent mainly because there are double oxides of the alcohol radicles and no corresponding double chlorides.

The following is a list of compounds wherein the trivalent character of the metal is apparent:—

1. Double compound of sodium-ethyl and zinc-ethyl..... $Na''' \left\{ \begin{array}{l} (ZnC_2H_5)' \\ C_2H_5 \\ C_2H_5 \end{array} \right.$
2. Sodium-triacetyl..... $Na''' \left\{ \begin{array}{l} C_2H_3O \\ C_2H_3O \\ C_2H_3O \end{array} \right.$
3. Absolute ethylate of sodium ..... $Na''' \left\{ \begin{array}{l} O \\ H \end{array} \right\} C_2H_4$
4. Double compound of absolute ethylate with hydrochloric acid $Na''' \left\{ \begin{array}{l} (OC_2H_5)' \\ H \\ Cl \end{array} \right.$
5. Double compound of absolute ethylate with sulphuretted hydrogen ..... $Na''' \left\{ \begin{array}{l} (OC_2H_5)' \\ H \\ (SH)' \end{array} \right.$
6. Double compound with chloride of acetyl..... $Na''' \left\{ \begin{array}{l} (OC_2H_3)' \\ C_2H_3O \\ Cl \end{array} \right.$
7. Acetate of ethylene-sodium..... $Na''' \left\{ \begin{array}{l} O \\ C_2H_3O \end{array} \right\} C_2H_4$
8. Valerianate of ethylene-sodium .... $Na''' \left\{ \begin{array}{l} O \\ C_5H_9O \end{array} \right\} C_2H_4$
9. Benzoate of ethylene-sodium ..... $Na''' \left\{ \begin{array}{l} O \\ C_7H_5O \end{array} \right\} C_2H_4$
10. Absolute amylate of sodium ..... $Na''' \left\{ \begin{array}{l} O \\ H \end{array} \right\} C_5H_{10}$
11. Acetate of amylene-sodium ..... $Na''' \left\{ \begin{array}{l} O \\ C_2H_3O \end{array} \right\} C_5H_{10}$
12. Valerianate of amylene-sodium.... $Na''' \left\{ \begin{array}{l} O \\ C_5H_9O \end{array} \right\} C_5H_{10}$

All of these bodies have been actually obtained, and will be found mentioned in my papers. In order to form an adequate idea of the numerical strength of this material, it should be borne in mind that the examples on the above list have, to a great extent, the character of typical cases. Thus Nos. 7, 8, 9, 11, and 12 are members of one class whose numbers are very moderately computed at ten thousand. And it should, also, not be forgotten that there has, as yet, been no general movement among chemists in search of double sodium compounds, but that search has been confined to one solitary chemist.

It will be observed that, although I continue to look upon sodium as tri-valent, yet that some alteration has been made in the formulæ of absolute ethylate of sodium, and of the isomers of the sodium-salts of the fatty acid. At first, I wrote—

$$Na''' \left\{ \begin{array}{l} (C_2H_4)'' \\ OH \end{array} \right.$$

now I have transferred the oxygen from the hydrogen to the ethylene, and, in place of regarding sodium as two-thirds saturated with ethylene and one-third with hydroxyl, I now regard sodium as one-third saturated with oxygen, one-third with ethylene, and one-third with hydrogen.

Adopting this modification of the formulæ, the various metamorphoses of the compounds may be exhibited with great simplicity and regularity. In particular, the reaction between iodide of ethyl and acetate of ethylene sodium (at first sight one of formidable complication) becomes regular and intelligible when viewed in the light of the new formulæ; it consists in the production of iodide of sodium, alcohol, and caproate of acetylinated ethyl:—

$$Na'' \left\{ \begin{array}{l} OC_2H_4 \\ | \\ (C_2H_3O) \end{array} \right\} Na''' \left\{ \begin{array}{l} OC_2H_4 \\ | \\ (C_2H_3O) \end{array} \right\} + {}_2C_2H_5I =$$

$$= Na_2I_2 + \left\{ \begin{array}{l} C_2H(C_2H_5)_2O \\ | \\ OC_2H_4(O_2H_3C) \end{array} \right\} + OC_2H_4H_2.$$

In the above list, sodium has always been written as tri-valent; it is, however, right to add that I am prepared to consider the metal as being five-valent in the double compounds of ethylate of sodium with hydrochloric acid, sulphuretted hydrogen, and chloride of acetyl. I have, on other occasions, contended that sodium is seven-valent in the crystalline compound of the ethylate with three molecules of alcohol. As will be gathered from my various papers on this subject, I regard sodium as never *mono-valent*, but as tri-, five-, seven-valent, and perhaps even higher. This paper has been restricted to organic compounds; on another occasion, I propose to exhibit the inorganic compounds of sodium in a new light.

II.

In this paper I propose to consider the function of sodium in the common compounds of the metal, and to enquire how far the ideas derived from the study of its organic compounds mentioned in the former paper are applicable to its common, well-known inorganic compounds.

Viewed in these organic compounds, sodium appeared as the representative—not of hydrogen, but of nitrogen; the task before me is, therefore, to represent,

if possible, the inorganic sodium compounds as modelled on the plan of the compounds of nitrogen.

As I have already stated on various occasions, common salt admits of being looked upon as a sodium compound of the second order of complexity, thus:—

$$Cl\,Na''' \text{———} Na'''\,Cl$$

and obviously a similar device might be applied to other well-known sodium compounds, such as the numerous soda salts.

I do not, however, propose to avail myself largely of a hypothesis of this kind on the present occasion, and am able to represent the metal as *unduplicated*, and, at the same time, trivalent in most of the compounds in question.

The following list of formulæ will speak for itself:—

Caustic soda	Na'''	$\left\{\begin{matrix} O'' \\ H \end{matrix}\right.$
Nitrate of soda	Na'''	$\left\{\begin{matrix} O'' \\ (NO_2)' \end{matrix}\right.$
Acetate of soda....	Na'''	$\left\{\begin{matrix} O'' \\ (C_2H_3O)' \end{matrix}\right.$
Sulphate of soda..	Na'''	$\left\{\begin{matrix} O'' \\ -(SO_2)''- \end{matrix}\right. O'' \Big\} Na'''$
Acid sulphate of soda.....	Na'''	$\left\{\begin{matrix} O'' \\ -(SO_2'')-(OH) \end{matrix}\right.$
Bleaching soda.....	Na'''	$\left\{\begin{matrix} (OCl)' \\ Cl \\ H \end{matrix}\right.$
Hypochlorite of soda	Na'''	$\left\{\begin{matrix} O'' \\ Cl \end{matrix}\right.$
Sulphuretted soda	Na'''	$\left\{\begin{matrix} S'' \\ H \end{matrix}\right.$
Common salt.....	Na'''	$\left\{\begin{matrix} Cl & Cl \\ \text{———} & \text{———} \\ \text{———} & \text{———} \end{matrix}\right\} Na'''$, or Na_2Cl_2
Anhydrous oxide of sodium	Na'''	$\left\{\begin{matrix} -O- \\ \text{———} \\ \text{———} \end{matrix}\right\} Na'''$, or Na_2O
Sulphuret of sodium	Na'''	$\left\{\begin{matrix} -S- \\ \text{———} \\ \text{———} \end{matrix}\right\} Na'''$, or Na_2S
Bromide of sodium.	Na'''	$\left\{\begin{matrix} Br & Br \\ \text{———} & \\ \text{———} & \end{matrix}\right\} Na'''$, or Na_2Br_2
Iodide of sodium...	Na'''	$\left\{\begin{matrix} I & I \\ \text{———} & \\ \text{———} & \end{matrix}\right\} Na'''$, or Na_2I_2
Amide of sodium...	Na'''	$\left\{\begin{matrix} (NH)'' \\ H \end{matrix}\right.$
Nitride of sodium...	$(Na_3)'''N'''$	

The list might be indefinitely extended, so as to exhibit the constitution of a host of double chlorides, bromides, and iodides. I will, however, content myself with formulating the Nessler reagent:—

$$Na'''\left\{\begin{matrix} (HgI)' \\ I \\ I \end{matrix}\right.$$

and will leave the rest to the imagination of my readers, who will find no difficulty in comprehending that to the new theory belongs the merit of rendering account of the vast number of double haloid compounds containing the alkali metals, which, according to the prevalent notion that the alkali metals are analogues of hydrogen, are regarded as mere freaks of nature, and as much as possible put out of sight.

Reverting to the new formula for caustic soda:—

The fact that caustic soda is volatile is an argument in favour of taking a single rather than a duplicate formula for that substance. (Possibly it will be found that when chloride of sodium seems to volatilise it really undergoes change into trichloride of sodium and metallic sodium—a view which is in harmony with various facts, notably, with the extraordinary power of chlorine to facilitate the volatilisation of metallic chlorides.)

According to the new theory, the action of sodium on water is as follows:—

$$Na''' + \left.\begin{matrix} H \\ H \end{matrix}\right\} O = HNa'''\left\{\begin{matrix} O \\ H \end{matrix}\right.$$

According to the theory at present in vogue, this reaction is thus:—

$$Na' + \left.\begin{matrix} H \\ H \end{matrix}\right\} O = \begin{matrix} H \\ Na' \end{matrix}\left\{\begin{matrix} O \\ H \end{matrix}\right.$$

The new theory, therefore, represents sodium as doing more than twice the amount of chemical work that is done by the metal according to the old theory. Instead of displacing one atom of hydrogen, sodium really displaces two atoms of hydrogen, and also combines with one of the displaced atoms. Hence the extraordinary quantity of heat generated by the action of alkali metals on water.

The ordinary theory of caustic soda, as a member of the water-type, is beset with difficulties and inconsistencies of many kinds. Why should caustic soda be so active a chemical reagent as it is? If alcohol and caustic soda be both of them built on the water-type, why should the former be so inactive and the latter so very active.

The new theory renders account of the energy of caustic soda. According to it this substance is, in one-third of its structure, the hydride of sodium, and, therefore, naturally endowed with abounding energy.

Berthelot's splendid discovery of the synthesis of formiate of soda is beautifully in harmony with the new theory:—

$$CO + Na'''\left\{\begin{matrix} O'' \\ H \end{matrix}\right. = Na'''\left\{\begin{matrix} O'' \\ COH \end{matrix}\right.$$

The production of bleaching soda, and, generally, oxidation under the influence of alkalies, are quite natural changes suggested by the very formulæ of the new theory:—

$$Cl_2 + Na'''\left\{\begin{matrix} O'' \\ H \end{matrix}\right. = Na\left\{\begin{matrix} Cl \\ (OCl)' \\ H \end{matrix}\right.$$

London, Dec. 24, 1869.

ON THE

ESTIMATION OF PEROXIDE OF MANGANESE IN MANGANESE ORES.

BY E. SHERER AND O. RUMPF.

The method of Fresenius and Will for the estimation of manganese, to which for so long preference has been given, has recently been objected to in England by the consumers of the ore. Attention has been called to the fact that this method shows, indeed, correctly the proportion of binoxide of manganese in the sample, but, on the other hand, does not represent its value as an agent for the production of chlorine.

The reason for this is that metallic iron or its protocompounds, which are often present in the ore, absorb oxygen to form a sesqui salt when the sample is treated with hydrochloric acid, but remain unchanged when it is treated with concentrated sulphuric acid and oxalate of soda.

In consequence of this, the method of Fresenius and Will is still used in some laboratories, while, in

others, it has been superseded by the iron method from which circumstance an uncertainty in the valuation of the article arises, disagreeable alike to purchasers and sellers.

This has led us to subject the various methods to a careful examination and comparison one with another. Our object was to ascertain, by a series of experiments, how far the estimations by the same method agreed one with another, and then to discover the causes of the differences that have been observed between the results obtained by the different methods.

A sample of American manganese was used for our experiments. A large quantity was pounded, well mixed, and carefully dried at 100° C. The moisture amounted to 0·749 per cent. Quantities of the dry manganese were then at once weighed off for the various tests.

I. *According to the Method of Fresenius and Will.*

Years of experience having proved to us the constancy of results obtained by this method, we considered that three trials would be sufficient. These served to show the actual amount of binoxide in the sample.

1. 2·1098 grms. manganese caused the evolution of 1·355 grms. carbonic acid = 63·49 per cent.

2. 1·5103 grms. manganese caused the evolution of 0·970 grms. carbonic acid = 63·49 per cent.

3. 1·3645 grms. manganese caused the evolution of 0·8770 grms. carbonic acid = 63·53 per cent.

II. *According to the Iron Method.*

The estimations by this process were conducted in the following manner :—

A weighed quantity of pianoforte-wire was dissolved in hydrochloric acid, in a glass flask. Carbonic acid was conducted into the flask during the operation, to prevent the oxidation of the protochloride of iron produced by oxygen from the atmosphere. When complete solution had taken place, a small tube, containing an accurately-weighed quantity of the manganese, was dropped into the flask, the mixture boiled until complete decomposition had taken place, and then cooled in the stream of carbonic acid. The excess of the protochloride was then estimated in the usual way, by means of a standard solution of bichromate of potash. The weight of the iron wire, multiplied by 0·997, was taken as the amount of pure iron used.

1.	0·8748 grms. manganese	Chromate of potash used,	
	1·0796 " pure iron	22·7 c.c. = 62·60 per cent.	
2.	0·7504 " manganese	Chromate of potash used,	
	1·03668 " pure iron	25·85 c.c. = 62·35 per cent.	
3.	0·8746 " manganese	Chromate of potash used,	
	1·1686 " pure iron	27·65 c.c. = 62·54 per cent.	
4.	0·7604 " manganese	Chromate of potash used,	
	0·9692 " pure iron	21·45 c.c. = 62·20 per cent.	
5	0·9312 " manganese	Chromate of potash used,	
	1·3846 " pure iron	38·2 c.c. = 61·97 per cent.	
6.	0·5467 " manganese	Chromate of potash used,	
	1·2183 " pure iron	46·8 c.c. = 61·39 per cent.	
7.	1·135 " manganese	Chromate of potash used,	
	1·0787 " pure iron	10·2 c.c. = 62·07 per cent.	
8.	1·0446 " manganese	Chromate of potash used,	
	1·0792 " pure iron	14·6 c.c. = 62·01 per cent.	

We therefore conclude, from these figures, that this method, proceeded with in the way we have described, does not yield accurate results.

III. *The Estimation of Manganese by the Formation of Chloride of Lime.*

The advantage that this method would seem to have over all others is that the manganese is treated in precisely the same manner in the laboratory as it is on the large scale in the manufacture of bleaching-powder.

Weighed quantities of the sample were treated with strong hydrochloric acid in a small flask until complete decomposition had taken place. The chlorine produced was conducted first into another flask, and then into a U-tube, both of which were filled with a weak milk of lime. The resulting chloride of lime was then tested by Gay Lussac's method, with arsenious acid.

			AsO_3. c.c.	per cent.
(1).	1·0561 grms.	manganese	53·90	= 62·60
(2).	1·0845 "	"	56·05	= 63·39
(3).	1·2045 "	"	61·70	= 62·83
(4).	0·4222 "	"	20·70	= 60·14
(5).	0·8102 "	"	39·75	= 60·18
(6).	0·4929 "	"	23·15	= 59·06
(7).	0·4875 "	"	23·15	= 58·15

These figures sufficiently prove that no accurate results are to be obtained by this method.

We next experimented on Bunsen's method.

Weighed quantities of manganese were dissolved in hydrochloric acid in the same manner as in the preceding. The escaping chlorine was received in a strong solution of iodide of potassium, and the liberated iodine subsequently estimated by means of a standard solution of hyposulphite of soda and a solution of starch. To prevent the solution of iodide of potassium from being sucked back into the generating-flask, a few small pieces of magnesite were introduced with the manganese, so that a continual slight escape of carbonic acid took place through the solution.

The solution of hyposulphite of soda was proved by means of a carefully-prepared pure iodine. 3·0436 grms. were dissolved in iodide of potassium, and diluted to 250 c.c. 10 c.c. of this solution required 17·90 c.c. of the hyposulphite of soda solution. 1000 c.c. of hyposulphite of soda solution would, therefore, correspond to 2·3294 grms. of binoxide of manganese. A second trial, in which 2·4767 grms. of the pure iodine were used, 1000 c.c. of the hyposulphite were found to correspond to 2·3319 grs. of binoxide of manganese, which two results closely agree. In testing the manganese—

			NaO,S_2O_2. c.c.	per cent.
(1).	0·6472 grs.	manganese	35·8	= 62·76
(2).	0·6427 "	"	34·6	= 62·73
(3).	0·6035 "	"	32·5	= 62·73

These results agreed so closely that we considered further estimations by this method to be quite unnecessary.

If we now compare the various results, we see that the sample, according to the method of—

	Average. per cent.	Greatest difference. per cent.
Fresenius and Will showed	63·50	0·04
Iron method showed	62·66	1·15
Chloride of lime estimation showed	60·90	5·24
Bunsen's method showed	62·74	0·03

From this, we see that only the methods of Fresenius and Will, and that of Bunsen, give constant results; and, of these two, the latter-named undoubtedly represented the value of the ore as an agent for the pre-

duction of chlorine, since only the chlorine evolved from the sample in the form of gas is estimated. We therefore may conclude that the method of Fresenius and Will gives results too high, while the iron and chloride of lime methods give results much too low. Our next step was to discover the reason for these differences. The cause of the high result obtained by the method of Fresenius and Will has already been mentioned at the commencement of this paper. We did not consider it necessary to examine whether or no the sample on which we were operating actually contained iron or its proto-compounds. The object we had in view was a purely practical one; and the possibility of the presence of such iron compounds in the ore cannot be disputed. The following experiment proves that a very considerable addition of metallic iron will not in the slightest degree affect the accuracy of the results obtained by this method. 1·4706 grms. of metallic iron were added to 2·4745 grms. of the manganese, concentrated sulphuric acid added, and the test proceeded with as usual. The result obtained—viz., 63·13 per cent—differed only by 0·37 per cent from the average of the three previous trials made by this method, notwithstanding that the amount of iron added was sufficient to render three-quarters of the manganese unavailable as an oxidising agent when dissolved in hydrochloric acid. Since varieties of manganese ore do contain the iron compounds of which we have spoken, we did not further investigate the question whether or no this was the only cause of the two high results which this method yields under certain circumstances. The reason of the uncertainty of the results obtained by the iron method, as, also, of their being generally too low, we discovered to be, that a slight loss of chlorine generally takes place during the operation. When the manganese is added to the protochloride solution, a greater or less quantity frequently floats on the surface of the liquid for a short time. A small quantity of chlorine is evolved from this, which has no opportunity of acting on the iron solution, and is carried off with the stream of carbonic acid. We convinced ourselves that this was the case by conducting the escaping gas into a second flask, which contained a small quantity of weak protochloride of iron solution. As soon as the manganese rose to the surface of the liquid in the decomposing-flask, a yellow color appeared in the liquid in the second flask, proving that a portion of the chlorine from the manganese escaped into the second flask, and there formed a sesquichloride of iron. The contents of the two flasks were then separately tested with the chromate of potash solution. From the first flask alone, the sample would seem to contain 2 per cent less than it actually does contain.

0·8129 grms. manganese.	
1·06519 grms. pure iron in first flask.	
25·8 c.c. chromate of potash used for first flask.....	60·48 per cent
0·989 grms. pure iron in second flask	
57·02 c.c. chromate of potash used for second flask.....	1·99 per cent
	62·47 per cent

This figure agrees tolerably well with the result obtained by Bunsen's method. This method can, therefore, be made to yield accurate results, but only by a difficult and troublesome arrangement, which makes it more complicated and longer than that of Bunsen. Instead of metallic iron, a proto-salt—such as the double sulphate of iron and ammonia—is sometimes used in the iron process, and the decomposition of the manganese effected by means of weak sulphuric acid. No loss of gas probably takes place in this method. Experience has shown us that it is very difficult to obtain such salts perfectly free both from sesqui-compounds of iron and moisture. We did not, therefore, experiment on this method.

The reason of the great irregularity in the results obtained by the chloride of lime methodis easily perceived. At 40° C., chloride of lime commences to be decomposed into chlorate of lime; so that a greater or less speed in the evolution of the gas will produce a greater or less warmth in the milk of lime, and, consequently, more or less decompose it. We endeavoured, by external cooling, to prevent this warming and decomposition, but with no satisfactory results, as the following figures will show. The milk of lime was cooled by the external application of a mixture of sulphate of soda and hydrochloric acid.

			AsO_5. c.c.	per cent.
(1). 0·3633	grms.	manganese	18·90	= 63·80
(2). 0·7778	"	"	38·45	= 60·64
(3). 0·8185	"	"	40·50	= 60·70
(4). 0·9204	"	"	46·25	= 61·64
(5). 0·6975	"	"	35·65	= 62·69
(6). 0·5581	"	"	26·85	= 59·01

This method can, therefore, only be used for approximate results.

In estimating the manganese by the method of Bunsen, the iodine liberated by the chlorine should be tested as soon as possible after the decomposition. The iodine solution from the tests numbered 1 and 2 were again tested after standing twenty-four hours. The results were both over 65 per cent. This was caused by the conversion of iodine into hydriodic acid. In conclusion, therefore, we may decide that the results obtained by Bunsen's method exceed all others in accuracy. Its simplicity, also, is greater than that of the iron method, as it requires only one weighing, and does not need a stream of carbonic acid. At the mines where tests continually have to be made, the method of Fresenius and Will would certainly appear to be the best and simplest, so much the more that here no accidental admixture of iron can have taken place.

In conclusion, we would suggest that it is more reasonable to represent the value of manganese rather by chlorometrical degrees than by the percentage of binoxide. Neither the method of Bunsen nor the iron method represent the percentage of binoxide, but the relative value of the ore as an agent for the production of chlorine; and, therefore, a similar form of expression for the value of chloride of lime and manganese, seems to us desirable.

Wiesbaden, Oct. 11th, 1869.

P.S. The foregoing paper is the result of experiments made at the laboratory of Dr. R. Fresenius, in Wiesbaden.

CAUSE OF BRIGHT LINE ON PARTIAL-PHASE ECLIPSE PICTURES.*

BY PROFESSOR HENRY MORTON.

During the progress of the eclipse of August 7th, I observed on the negatives, taken during the partial phase by the section of my party with which I had located

* Communicated by the Author.

myself, a decided increase in the opacity of the silver deposit in immediate contact with the advancing edge of the moon. When, after our return to Philadelphia, all the negatives taken by the other two sections were handed over to me, I found the same characteristic appearance, varying only slightly in degree, to distinguish all of them, and this had, of course, been noticed by those engaged in making the pictures. In fact, many remarks have been made upon this point, and some deductions drawn from it.

On the paper prints prepared from these negatives this local density produced a line of light in contact with the moon's limb.

An appearance similar to this had been observed by Professor Alexander, in the photographs taken during the eclipse of 1860, as also by Mr. De la Rue, and while ascribed by Professor Challis and Professor Alexander to a very rare lunar atmosphere, had been explained by Mr. De la Rue and the Astronomer-Royal, as a subjective effect.

The Astronomer-Royal had, moreover, shown, in papers published in the *Monthly Notices* of the Royal Society, 1863, Nov. 13, and 1864, June 10, that no such effect would be produced by a lunar atmosphere, were it present. He, therefore, very justly discards such a supposition, and, by satisfactory experiments, shows that the light line in *the prints under his examination* is an optical illusion, and not an existing fact.

These experiments, however, when applied to good prints of our pictures, did not show the same result, and, beside, the actual opacity of the negatives seemed to preclude the above explanation as one accounting for the *entire* effect.

I therefore made the following experiment:—I converted one of the solar pictures, taken soon after first contact, into a crescent, by pasting partly over it a dark circular piece cut from another print. This showed a faint line of light, such as results from contrast, and which was no doubt found in the pictures examined by the Astronomer-Royal.

I then had this artificial eclipse-picture photographed (through the kindness of Mr. James Cremer), when negatives were produced showing a dense deposit along the lunar edge, and giving prints which showed a bright line in the same place, far more decided than that seen in the artificial original.

It thus appears that the effect observed in these eclipse pictures, while not due to any lunar inflection of sunlight, is also not due to an optical effect of contrast solely, but is, in great part, due to a chemical action, which may be explained by what we know of the chemical reactions concerned in the production of a negative.

It is well known that the development of a negative depends upon the presence of free nitrate of silver in the film, and that a great strengthening or intensifying may be produced by re-immersion in the silver bath, and a second application of the developer. Now, in the present case, part of the plate representing the dark edge of the moon, and, therefore, not acted upon, furnishes a reservoir of nitrate of silver, imbibed by the collodion film, which, during the development, penetrates for a short distance into the portion representing the *luminous* area of the sun whose supply of free nitrate was exhausted by the reaction which occurred at the first moment when the developer was applied.

My conclusion, then, is, that while a certain effect in the paper prints is, and was on former occasions, due to "contrast," yet, in the present instance, the peculiar appearance of the negatives, and most of that seen on the prints, is the result of a chemical action such as I have described, and does not represent any celestial phenomenon. The *appearance* of a bright line in the same place which has been noted by several observers is, we believe, due simply to the contrast of the sharply-defined lunar edge, which produces the faint line above mentioned, in the artificial eclipse picture before described.

REPORTS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, December 2nd, 1869.

Dr. A. W. Williamson, F.R.S., &c., *President, in the Chair.*

The minutes of the previous meeting having been read and confirmed, the following certificates were read:—

For the first time—James Bell, Howell Hill, Ewell; G. R. Hislop, Gas Works, Paisley; William Ladd, Beak Street, Regent Street; Alfred Bird, Worcester Street, Birmingham; H. Seward, 15, Barnsbury Park, N; Edwin Lepper, 11, Maiden Lane, Queen Street, Cheapside, E.C.

For the second time—Samuel Jefferson, Secretary to the Yorkshire Board of Education, Woodville Terrace, Woodhouse Lane, Leeds; Clements Higgins, Demonstrator of Chemistry, King's College, London; James John Bourey, Analytical Chemist, 10, Stepney Causeway, E.

For the third time—Matthew H. Cochrane, 108, Paul Terrace, Glasgow; Edward Smith, Practical and Pharmaceutical Chemist, Strand, Torquay; Thomas Walton, M.R.C.S., and L.S.A., Lecturer on Chemistry at the Hull and East Riding School of Medicine, Kingston-upon-Hull; G. Manley Hopwood, 22, Grosvenor Square, All Saints, Manchester; John Wiggin, Pharmaceutical and Analytical Chemist, Ipswich; Thomas Gibb, A.R.S.M., Engineer; George Harrison, Analytical Chemist, 26, Havelock Square, Sheffield; Sir Roderick Impey Murchison, Bart., F.R.S., Belgrave Square.

The last-named gentlemen were balloted for and duly elected.

The first paper read was entitled "*Remarks on some Points in the Nomenclature of Salts*," by H. G. Madan, F.C.S.

The author calls attention to the unsettled state of chemical nomenclature, and the difficulty of teaching the science while hardly two of our text-books adopt the same system of names, and while specimens of so many totally different systems are to be found in our periodicals. He then refers to the terminations to the electro-negative radicles, such as *-ide*, *-ite*, and *-ate*, and suggests that the accepted principle of indicating the amount of oxygen in the radicle by a change of a vowel in the name might be extended, so as to embrace such substances as chlorine and sulphur, which form, with oxygen, more than two radicles.

To distinguish the several members of each group of salts containing the same electro-negative or electro-positive radicle, the author prefers rather to add a prefix, such as *proto-*, *di-*, *tri-*, *per-*, &c., to the existing generic name for the salts of the electro-negative radicle with which it is associated than to change the termination of the name of the electro-positive radicle into *-ic* or *-ous*, as the prefix requires the least alteration in existing names, and is the more elastic system of the two.

Mr. Madan does not see the advantage of calling radicles by their Latin names, such as *argentic* nitrate or *ferrous* chloride, but if such a system is considered convenient, it should be carried out consistently, by using such terms as *kalic*, *natric*, *stibic*, *hydrargic*, &c. The system of terminology proposed by Mr. Harcourt,* and adopted by Roscoe and

* Chemical News, vol. xvi. p. 272; *Am. Repr., Jan.* 1868, *page* 28.

[English Edition, Vol. XX., No. 527, page 313; No. 524, pages 280, 281.]

Watts, is, in the opinion of the author, more simple, permanent, and yet elastic, than any other.

Professor Attfield thought the chief point about a name should be that it was unalterable. He objected to the use of vowels or of Latin or Greek numerals to express the name of a salt, as their views of the constitution of a substance sometimes changed, and when such was the case, it became necessary to alter the name.

The President said that Mr. Madan's proposal to revert to the use of such terms as *proto-*, *sesqui-*, and *per-* in order to designate the place of bodies which differ in their quantity of oxygen and chlorine in a series, implied that the series was known, whereas we are constantly altering our knowledge of such series. These words had been productive of considerable inconvenience and confusion, and he thought the terminations *-ous* and *-ic*, as used by most writers, including Mr. Roscoe and Mr. Watts, were far more convenient. These terminations only denote a kind of difference in the constitution of certain substances; such a difference might be ascertained as a matter of fact. They might find other terms of each series, and a body which was first might become second, but if it contained less oxygen than another, it was correctly distinguished by the termination *-ous* instead of *-ic*. Mr. Madan seemed to think it necessary always to retain Latin words if they were used in certain cases. It was held by some persons that a variety of name was in many cases desirable amongst such compounds as Prussian blue, where iron figured in two capacities. He, the speaker, was not aware that those who advocated the view against which Mr. Madan contended had ever asserted that a Latin name, if used at all, ought universally to be employed; and if English names were insisted on, they would be led into eccentricities not less remarkable than those against which the author contends. Carbon and sulphur were Latin words which, if discarded in favour of the English words, would lead to words like charcoalic oxide and charcoalic acid, and brimstonic acid and brimstonous acid, a change which did not appear to him a very great improvement. It was exceedingly desirable that everybody should bring forward his own impression in the matter, because it was only by general consent that any important system could be established.

Mr. Vernon Harcourt thought the difficulty attaching to the choice of names was inevitable in the present state of chemistry. Either a name must be unsystematic, and merely express one or two facts about the particular substance, *e.g.*, corrosive sublimate; or, if it was systematic, and expressed a relation between the particular substance and others, it must embody a theory not yet definitely established. With reference to English and Latin names, sulphur had for so long a time been used as an English word, that it was, in reality, no less so than brimstone. The latter, he supposed, was a German word, and sulphur was, originally, Latin, but it had now become as thoroughly English as any word in the language. With regard to using *ic* and *ous*, he thought that the terminations *proto* and *per* might equally be said to express facts; and it appeared to him that the objection raised by Mr. Madan, that the terminations *-ic* and *-ous* served only for two terms of a series, and that this mode of expression cannot be extended in cases where the series extends beyond two terms was a just one. At the same time, he thought that, where there were two parallel series of salts (such as mercurious and mercuric salts, ferrous and ferric salts), it was a great convenience to have these terms, and "ferrous salts" was, perhaps, a better expression than "iron proto-salts," which Mr. Madan recommended as a substitute.

Mr. McLeod remarked that there was a certain excuse for the use of Latin words, for, in almost all cases, they referred to the symbol.

Dr. Odling said that Mr. Madan spoke of the convenience which occasionally attached to their being able to use such a word as "proto-salts," and to speak of proto-salts in general. It would be a real advantage if all proto-salts were conceived to have the same constitution; but, as the word proto-salts did not express the constitution any more than *-ic* and *-ous*, he could not admit that argument to have any weight in favour of the use of such words as *proto-* and *per-* rather than of *-ic* and *-ous*. He was rather inclined to agree with Mr. Harcourt's observations in defence of the English. Respecting such words as mono-chloride and bi-chloride of mercury, it was quite true that, if they used them, they meant that the one contained double the quantity of chlorine in the molecule to the other, and not merely double the ratio of the mercury and the chlorine.

The President hoped it would not be understood that he insisted on Latin names in preference to the English. When Latin names were more easily modified than English, by all means use them; but, when such was not the case, refuse them. It would not be worth while to employ English words instead of the Latin aluminium, chromium, &c.; and it should not be argued that, because they used English words in some cases, that therefore they must use them in all cases. The whole genius of the English language was at variance with that proposition. They wanted an intelligible principle to guide them, instead of the fixed names, which imply particular theories of the constitution of bodies. With regard to *-ic* and *-ous* only adapting themselves to one term of a series, he conceived that, as long as they had to do with the properties of bodies in chemistry, the difference between acid and basic bodies would be one of the chief things to refer to; and, if the business of names was to recall the chief properties of bodies, he thought it must be an advantage, in describing terms of a series, to use some name to distinguish those which were not acid from those which were.

Professor Voelcker said that, in one aspect, uniformity of nomenclature had great advantages; but he was not sure that one and the same chemical compound, having two, three, or four different names, was an unmitigated evil. In teaching chemistry, he would not object to a substance being called by the empirical name, if, by this means, certain properties were fixed upon the mind of the student, by which he became familiar with a certain definite substance. He might afterwards be told to call it by another name, and then by a third; and, when he was once familiar with the real nature of the substance, it was immaterial whether he knew it by one name or the other. By the same combination having different names, the teacher would be able to illustrate the different views entertained by chemists of the constitution of a substance.

The next paper was on "*Results of the Analysis of Sea Water Performed on board H.M.S. Porcupine, July*, 1869," by John Hunter, M.A., F.C.S.

The first part of this paper is devoted to abstracts of papers published on this subject by Darondeau, Aime, Bischof, Hayes, Morren, and Thorpe, given by the author to show that very little has been done in investigating the gases contained in the ocean at any great depth, and that the various experiments had not yielded identical results. To collect the water for his experiments, the author used a large brass tube, attached to the sounding-line. Two valves were placed in the tube, one at the upper end, the other below, but both opening upwards, so that, when descending, the water flowed freely through, but, when drawn up, the pressure of the external water closed the valves, and the sample of the last water which had entered the tube was secured. Soo c.c. were placed in a flask, and the gases determined by boiling, according to the method of Dr. Miller. The amount of organic matter was observed by Dr. Miller's process, and the specific gravity was also taken. Two series of experiments were made. In the first, the specific gravity of the bottom water was rather less than that of the surface; but, in the second series, they were identical. The carbonic acid was found to be in greatest quantity at the bottom: it then diminished a certain amount, and remained pretty constant until within about 100 fathoms of the surface, when it diminished still more. The

amount of organic matter was about the same in bottom and surface water.

At the end, Mr. Hunter gives the results of his experiments in a tabulated form.

Mr. McLeod thought that, if the absolute quantity of carbonic anhydride or carbonic acid gas in 100 volumes of water had been given, the results would then have been more comparable, and the relation between sea water and ordinary spring water would be shown. The total quantity of gas in 100 volumes of sea water was much less than he would have expected, and less than is found in ordinary river waters. Thames water, he thought, contained 6 volumes in 100 of the three gases together; while the largest proportion of gas in sea water, according to Mr. Hunter, was only 2·8 in 100. It had been stated that sea water brought from a depth effervesced like soda-water; but that would seem to be almost an impossibility if the quantity of gas obtained was as low as 2·8. It was just possible that, in collecting the water, if there was any pressure in the tube, it would open the upper valve, and allow nearly all the gas to escape; but he (Mr. McLeod) was not in a position to suggest a better apparatus than the one described.

The President thought that, if it were soda-water below, they ought to cork it up before bringing it to the surface; but the results obtained by Mr. Hunter did not agree with the soda-water theory. He did not see that the gas should have any tendency to come off from the water, when there was so little of it there; but the quantities might not, perhaps, have been so great as reports made of experiments would lead one to expect.

The Society then adjourned to the 16th inst.

Thursday, December 16th, 1869.

Dr. A. W. Williamson, F.R.S., &c., *President, in the Chair.*

The minutes of the previous meeting having been read and confirmed, the following certificates were read:—

For the first time:—Pedlar, Royal College of Chemistry.

For the second time:—James Bell, Howell Hill, Ewell; G. R. Hislop, Gas Works, Paisley; William Ladd, Beak Street, Regent Street; Alfred Bird, Worcester Street, Birmingham; H. Seward, 15 Barnsbury Park, N.; Edwin Lepper, 11 Maiden Lane, Queen Street, Cheapside, E.C.

For the third time:—Samuel Jefferson, Secretary to the Yorkshire Board of Education, Woodville Terrace, Woodhouse Lane, Leeds; Clements Higgins, Demonstrator of Chemistry, King's College, London; James John Bourey, Analytical Chemist, 10 Stepney Causeway, E.

The last-named gentlemen were balloted for and duly elected.

Mr. McLeod gave a verbal account of some experiments he had made on the presence of gases in sea water. At the last meeting he had stated from memory that Thames water contained 6 volumes of gas in 100 of water: on referring to his note-book he found that 100 vols. of this water contained—Nitrogen, 1·398; oxygen, 0·619; carbonic anhydride, 4·180; giving a total of 6·197 vols. in 100 vols. of water. He had experimented upon some sea water collected at Worthing, some distance from the outfall of any river, and which had been exposed to the air for twenty-one months, and found that the amount of gas in 100 vols. was—Nitrogen, 1·104; oxygen, 0·572; carbonic anhydride, 2·620; the total being 4·296. This was very much in excess of the quantity found by Mr. Hunter, as recorded in his paper read at the last meeting, but the quantity of carbonic anhydride was much smaller than might have been expected. The hardness of sea water was greater than that of Thames water, and therefore one would expect a larger quantity of anhydride to have been produced by the distillation. He intended, if possible, to collect some water from the surface of the sea, and to ascertain what quantity of gas it contained.

The President, in thanking Mr. McLeod for his communication, said Dr. Hugo Müller had, he thought, made experiments on the condition of carbonic gas when dissolved in water which led to remarkable results.

Dr. Hugo Müller, in experimenting on the manufacture of soda-water in an apparatus which was formerly much used, found that if the carbonic acid remained in contact with the water for twenty or twenty-four hours, it disengaged itself gradually, adhered to the sides of the glass, and appeared altogether different than when it was left only a short time in contact with the water. He had also noticed that, with the addition of a little common salt, the carbonic acid dissolved much quicker, the chloride of sodium being actually decomposed by the carbonic acid, hydrochloric acid and bicarbonate of soda being formed. He had proved the presence of hydrochloric acid, by ultramarine, which was neither acted upon by carbonic acid nor chloride of sodium. Another instance, in which the chloride was decomposed by carbonic acid, was when carbonic acid was passed through a neutral solution of chloride of lead. In a short time a clear solution was obtained, and, after a certain time, a precipitate consisting of chloro-carbonate was formed.

Dr. Divers observed that, if rectified spirit were mixed with distilled water which contained air through exposure, a kind of effervescence occurred, which he supposed was due to the formation of minute bubbles of air being liberated and rising to the surface. This seemed to show that a mixture of spirit and water had less solubility for air than pure water itself.

The President wondered if the temperature had anything to do with the peculiar state in which Dr. Hugo Müller found the carbonic acid. He had been looking over Dr. Andrews's experiments on the states of carbonic acid at different temperatures, and it would seem that a few degrees of temperature made a great deal of difference in the proportion of the acid, which was not overcome by enormously multiplying the pressure. The observations on the greater solubility of carbonic acid in water containing sodic chloride he thought of great theoretical value, confirmed as they were by the ultramarine test. He (the President) had held, for years, that salts generally dissolved in water by decomposition, and he was interested to find his view confirmed by the introduction of the ultramarine test for the presence of free hydrochloric acid.

After some further remarks from Dr. Hugo Müller, on the chloro-carbonate of lead reaction,

The President alluded to a reaction he had published twenty-four or twenty-five years ago—viz., the action of chlorine in water in the presence of salts like sodic sulphate.

The meeting was then adjourned to January 20th, 1870.

ROYAL INSTITUTION OF GREAT BRITAIN.

General Monthly Meeting, Monday, December 6, 1869.

George Busk, Esq., F.R.S., *in the Chair.*

George Henderson Gibb, Esq., William Harbottle, Esq., John Henderson, Esq.; and Henry Musgrave Musgrave, Esq., were elected Members of the Royal Institution.

The following lecture arrangements for the ensuing season were announced:—

Professor Tyndall, LL.D., F.R.S.—Six lectures (adapted to a juvenile auditory), "On Light." On December 28th, 30th, 1869; January 1st, 4th, 6th, 8th, 1870.

Before Easter, 1870.

Professor Humphry, M.D., F.R.S.—Six lectures, "On the Architecture of the Human Body." On Tuesdays, January 18th to February 22nd.

Professor Odling, F.R.S.—Twelve lectures, "On the Chemistry of Vegetable Products." On Thursdays, January 20th to April 7th.

Robert Scott, Esq., M.A., Director of the Meteorological Office.—Four lectures, "On Meteorology." On Saturdays, January 22nd to February 12th.

Dr. Masters, F.L.S.—Two lectures, "On Plant Life as Contrasted with that of Animals." On Tuesdays, March 1st and 8th.

Professor Rolleston, M.D., F.R.S.—Four lectures; "Deductions from the Comparative Anatomy of the Nervous System." On Tuesdays, March 15th to April 5th.

Professor Max Müller, M.A., LL.D.—Four lectures, "An Introduction to the Science of Religion." On Saturdays, February 19th to March 12th.

Joseph Norman Lockyer, Esq., F.R.S.—Four lectures, "On the Sun." On Saturdays, March 19th to April 9th.

After Easter.

Professor Blackie.—Four lectures, "On the Principles of Moral and Political Philosophy." On Tuesdays, April 26th to May 17th.

Professor Tyndall, LL.D., F.R.S.—Seven lectures, "On Physics." On Thursdays, April 28th to June 9th.

Professor Robert Grant, LL.D., F.R.S.—Seven lectures, "On Astronomy." On Saturdays, April 30th to June 11th.

Professor Seeley.—Three Lectures, "On History." On Tuesdays, May 24th, 31st, and June 7th.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

MICROSCOPICAL AND NATURAL HISTORY SECTION.

November 8, 1869.

Joseph Baxendell, F.R.A.S., *Vice-President of the Section, in the Chair.*

The following note was read from Mr. Joseph Sidebotham:—

About fifteen years ago, I had a large cabinet, made of forty-five drawers, to contain shells and carpological specimens, the drawers being made of pencil-cedar. Very soon I found that the resinous vapour from the wood became deposited on some of the fruits and shells, making them appear as if they had been dipped in varnish. Chloroform appeared to be the only solvent, and the specimens were obliged to be washed with it. This became so bad that I had the whole of the drawers removed, and replaced with drawers of baywood. Some time afterwards, Mr. Carter advised me to have the cedar drawers sized and papered inside, and a new cabinet made to contain them. Accordingly, he made me one to contain thirty drawers. These drawers were exposed to the air for twelve months, and very well sized inside, and papered; but the resinous vapour is still deposited on the objects in the drawers as before, and, so far, is a warning to every one never to use pencil-cedar for such a purpose. I should not, however, have thought this matter worthy of mention before the Section, had it not been for the very curious and capricious way in which some objects are coated with this resin, while others are left entirely free, and for which I am totally unable to account. In shells, the genera *Conus* and *Oliva* are never touched by it, nor are *Cypræa* or *Mitra*, whilst *Helix*, *Bulimus*, and *Pecten* are coated over. This is the case when there are specimens of these and other genera in the same drawer. As this deposit is on the genera I have named, and never on the others, it would seem to indicate that the texture of some shells would attract the vapour, and not others; but, in the case of birds' eggs, the very strange manner in which some species are picked out, as it were, and others left, is most remarkable. In the owl's eggs, for instance, the barn owl is always free, while the tawny owl is covered with the varnish although side by side. The song thrush is never attacked, and the missel thrush always.

Trays exhibiting these peculiarities were passed round for inspection.

Ordinary Meeting, December 14, 1869.

J. P. Joule, LL.D., F.R.S., &c., President in the Chair.

Sir Charles Lyell, Bart., LL.D., D.C.L., F.R.S., &c., and Henry Clifton Sorby, F.R.S., F.G.S., were elected Honorary Members of the Society. Mr. Robert Routledge was elected an Ordinary Member.

Mr. William Boyd Dawkins, F.R.S., exhibited some old mining tools, brought over by Mr. Bauerman from the turquoise mines of the promontory of Sinai, consisting of a stone-hammer and rude splinters of flint. The turquoises occur in a bed of a quartzose mottled sandstone, in Wady Sidreh and Wady Maghara, in joints running, for the most part, north and south. They were worked, according to the evidence of the hieroglyphic inscriptions on the rock, by the Egyptians from the third to the thirteenth of the dynasties mentioned by Manetho. In and around the workings there are still the tools with which they were carried on. Innumerable splinters of flint, with their points blunted and rounded by use; stone-hammers, some of which are broken; and rounded pebbles, with a concavity on either side, caused by the friction of the thumb and finger, charged with particles of sand; and segments of small wooden cylinders, lie together. The flint flakes exactly coincide with the grooves in the rock made in the excavation, and evidently have been blunted by such use. The fragments of wooden cylinders are believed by Mr. Bauerman to have been portions of the sockets into which the flakes were fitted. The round pebbles were probably used for driving the rude chisel formed by the flint inserted into the wooden socket; while the large stone-hammers were used for breaking up the rock. There was no evidence that metal of any kind was used in the work. Mr. Bauerman also satisfied himself that the hieroglyphs were cut with implements similar to those used in the mining. This discovery is very important, because it opens up the question as to what tools the Egyptians used in working their wonderful monuments of granite and syenite. If it were worth their while to conduct turquoise mining with flint flakes in the Sinaitic promontory, and if they used the same tools in the hieroglyphs that fix the date of these mines (and of this there can be no reasonable doubt), it is very probable that they employed the same means for the same end elsewhere; and that, to say the least, a part of their marvellously minute sculpture in Egypt has also been wrought with flint. There is no evidence that they were acquainted with the use of steel. Iron and bronze are not hard enough for the purpose. The minute and delicate sculpture left behind by the Mexicans, which can be proved to have been worked with stone tools, adds to the probability of this view.

GLASGOW PHILOSOPHICAL SOCIETY.

(Chemical Section.)

The ordinary meeting of the Section was held on the evening of Monday, December 6th, Mr. William R. Hutton, Treasurer, presiding. Several candidates were proposed for admission, and several others were balloted for.

The first paper read was entitled, "*Note on the Action of House Sewage on Lead Pipes.*" In introducing it, the author,

Mr. Edward C. C. Stanford, F.C.S., referred to the panic which had recently been shown by the voluminous correspondence in the local papers regarding the alleged impurity of the water used for domestic purposes, and stated that it had revived the old question of the action of the purer kinds of potable water on the lead of the pipes and cisterns. The panic, known locally under the name of "death in the cistern," had been completely allayed by the remarkable unanimity of the reports prepared by Dr. Anderson, Professor of Chemistry, and Dr. Wallace, Analytical Chemist, and backed by an eminent medical authority like Dr. W. T. Gairdner. Notwithstanding, however, that the amount of lead was small, a sufficient quantity had been found in almost all the

analyses of the cistern water to show the desirability of avoiding all suspicion of lead contamination, by adopting a constant high-pressure service in iron pipes, and, where they are required, of using cisterns of iron or slate. The author remarked that much attention had, from time to time, been directed to the action of the purer kinds of potable water upon lead; but it was somewhat remarkable that an equally-important and much wider-spread evil of a similar character had escaped notice. He referred to the serious deterioration which lead pipes undergo which are connected with water-closets; and he brought this subject under the notice of the Section in order that some light might be thrown upon the cause of the said deterioration. Dr. Fergus, a Glasgow medical gentleman, had the credit of first directing attention to the subject by tracing a close connection between the deterioration of the soil-pipes and the existence of various forms of low febrile disease in the houses into which, from the degenerated condition of the pipes, sewer-gases make their escape. By means of sketches and used-up specimens of soil-pipes, the author showed the nature of the action to which the pipes are subject from long use—the length of time varying from ten to sixteen years. Near the bend of the pipe leading from the closet the upper part becomes coated with a greyish white deposit that can be easily scraped off, and the interior of the pipe becomes pitted; while, exteriorly, the pipe is at first blistered at the parts corresponding to the internal "pits," and in course of time it becomes quite riddled with holes, and quite gnawed away as it were. Mr. Stanford had analysed samples of the deposit from several soil pipes, and had found from 86 to about 93 per cent of the deposit to consist of plumbic carbonate, the other ingredients being calcic carbonate, silica, insoluble plumbic oxide, water, and organic matter. After noticing the chemical compounds which, in solution in water, act readily upon lead, the author said that the deterioration referred to was not due to those substances, inasmuch as they were found in the excreta, whereas the injury to the pipes took place in the air-space of the bend, and not in the water-space in which the "trapping" was effected. It has been remarked by plumbers, that a piece of lime, or newly-mixed mortar, in contact with a pipe, rapidly eats through it, probably by the lime combining with the carbonic acid of the outside film, and so cleaning the lead that the action of the air repeats the process. In the opinion of the author, alkalies would probably have the same effect as lime, and so clean the lead that a moist atmosphere would act on it. The effect of pure water on lead is first to dissolve it as oxide, and then this is precipitated as oxycarbonate, which is very insoluble, pure water only dissolving 1-60th of a grain per gallon. Water free from air does not act on lead; and the author therefore thought the action referred to might be due to the air carried down by the rush of water while the closet was acting, and by the carbonic acid, or by the ammonia of the gases of decomposition acting as a cleaner, the interior of the pipe being always in a moist condition. Mr. Stanford concluded by recommending the discontinuance of lead soil pipes, and the substitution of earthenware syphons and flanged cast-iron pipes.

Dr. Fergus, in opening the discussion, recommended that soil pipes should be ventilated, or that they should be used as the rain-water pipes. He gave some instances, in his professional experience, of the connection between such diseases as gastric fever, diphtheria, &c., and bad soil pipes; and he strongly urged the periodical investigation of such pipes.

Mr. Sutherland suggested that the action might be due to sulphuretted hydrogen or acetic acid; but Mr. Stanford said that plumbic sulphide had never been found in his analyses.

Mr. Anderson believed that nitric acid, resulting from the oxidation of ammonia, might have some influence in producing the injurious effects on the pipes. This view was supported by Mr. Hutton and Mr. Tatlock. The first-mentioned gentleman referred to experience extending over sixteen years, and said that Loch Katrine water is very peculiar, in having an abundance of dissolved oxygen and very little carbonic acid, and that such water rapidly acts on lead, producing oxycarbonate, which is readily soluble in fresh water from the same source.

Mr. Stanford replied that he had never met with nitrates in the course of his experiments.

A vote of thanks was awarded to Mr. Stanford.

A paper was then read by Mr. R. T. Tatlock, F.C.S., "*On the Estimation of Iodine and Bromine, with special reference to the Analysis of Kelp.*" We are compelled to hold over this paper for a week.

The ordinary meeting of this section was held on the evening of Tuesday last, Dr. Wallace, F.R.S.E., one of the Vice-Presidents, in the chair. Several new Associates were balloted for and admitted. Thereafter,

Mr. W. R. Hutton, manufacturing chemist, read a paper "*On the Chemistry of Coal-Smoke.*" The author glanced at the subject both in its sanitary and its economical aspects; and then, in order that the scientific principles involved in the prevention of smoke, and in the complete utilisation of the heating power of raw coal, might be properly understood, he gave an analysis of best Wishaw coal, one of the finest kinds of fuel in Scotland. It was as follows:—

Water	2·8
Sulphur	0·4
Volatile matter	36·9
Fixed carbon	56·3
Ash	3·6
	100·0

Volatile Matter.

Carbon	14·0
Hydrogen	6·0
Oxygen	15·9
Nitrogen	1·0
	36·9

In the ordinary combustion of coal, black smoke, and therefore soot, is only producible from the volatile matter of the coal, the fixed carbon, ash, &c., being incapable of generating smoke. The value of a fuel as a generator of heat is estimated according to the amount of carbon and hydrogen present in it. As ordinarily used, coal, during its combustion, gives rise to many curious compounds, including carbonic oxide, carbonic acid, watery vapour, ammonia, sulphurous and sulphuric acids, and various hydrocarbons, some of the paraffin series, and others of the naphthalin series; and, as they are volatile when liberated, they rise into the atmosphere and form the mixture known as coal-smoke. This material differs in its properties and composition, according to the composition and mode of burning the coal; but, in all cases, sooty carbon and moisture are abundant, the former especially so in black smoke. But black smoke is soot, and is the result of the imperfect combustion of the coal, and even of its wasteful use. Mr. Hutton then went on to examine soot in its chemical aspects, and explained, in detail, how the difference of temperature in a furnace or domestic fire regulates the composition of the volatile matters of soot. The composition of London and Glasgow soot was shown in a table, of which the following is a copy.

Analysis of Soot.

	London.	Glasgow.
Carbon	53·18	35·7
Tar and oil	18·00	15·0
Ammonia	1·75	2·8
Potash	0·20	0·3
Soda	0·34	0·3
Lime	1·00	0·8
Magnesia	0·30	trace

	London.	Glasgow.
Phosphate of lime and alumina.	2·08	3·2
Iron	0·40	0·7
Sulphuric acid	4·60	7·9
Chlorine	trace	0·4
Sulphocyanogen	0·25	none
Carbonic acid	0·70	trace
Sand	14·40	25·7
Water	2·80	7·2
	100·00	100·0

The author said he could guarantee the genuineness of the sample of London soot; but he was afraid that the Glasgow soot which he had examined was adulterated, judging by the large percentage of sand and water contained in it. The large proportion of sulphuric acid might be accounted for by the sulphurous quality of the Scotch coal, and by the great number of chemical works in Glasgow. Genuine Glasgow soot ought to contain a larger amount of ammonia: both samples were distinctly acid. While referring to the various uses of soot, Mr. Hutton mentioned that a considerable quantity was recently shipped to the West Indies, to be used there for the growth of the sugar-cane. The price is from 30s. to 40s. per ton. Considering that soot rarely contains less than about one-sixth of its weight of hydrocarbon compounds, the author of the paper proceeded to look at the production of soot from a commercial point of view, and asked if the value of soot is proportionate to the evils resulting from the production of the material. Not more than 500 tons are gathered in Glasgow per annum, and the value never exceeds £1000. Taking the waste of fuel, the loss of the nitrogen of the coal, the destruction of property, and the personal discomfort resulting from smoke and soot, he found that there was no profit, but rather a great loss instead. As a practical solution of the "smoke nuisance," Mr. Hutton briefly sketched a plan by which practically smokeless fires might be obtained, while all the volatile compounds could be separately collected, and be got in a form fit for utilisation. He would distil the coal before burning, stopping short the process of distillation at such a stage as would permit *soft coke* to be formed—that is, fixed carbon with a sufficient amount of volatile matter in it to render it slightly inflammable. The other useful products would be chiefly crude oil, coal-gas, and ammonia. Assuming, as a basis of calculation, 2000 tons of coal to be used daily, that amount would yield, in round numbers—

Soft coke	1400	tons.
Crude oil	40,000	gallons.
Ammoniacal water	30,000	"
Coal gas	6,000,000	cubic feet.

Deducting the ash, the fixed carbon would be reduced to 1329 tons. Mr. Hutton calculated that the coke and the other products would realise £742, while the coal (at 5s. per ton) and the labour, &c., would cost £600, leaving an apparent balance of £142, in addition to all the other advantages which would result from the complete combustion of the fuel. The coke would be such a material as would be available alike for domestic fire-places and the furnaces of steam-boilers, &c.

At the conclusion of the paper, various members spoke in commendation of Mr. Hutton's views. In reply to Mr. Stanford,

Mr. Hutton stated that such coke as he had suggested in his paper could be burned in the ordinary grate, without the expense or any other of the inconveniences attending the use of the grate which was devised some years ago by the late Dr. Neil Arnott.

On the motion of the Chairman, a cordial vote of thanks was awarded to Mr. Hutton; and the meetings of the Section were adjourned for a month.

ROYAL IRISH ACADEMY.

The general meeting of this society was held on Tuesday, November 30th, Right Hon. the Earl of Dunraven in the chair.

The first business was the election of a president, in room of Lord Talbot de Malahide.

Dr. Loyd, Provost of Trinity College, moved that the Rev. John Jellett, F.T.C.D., be elected president. He said that Professor Jellett's high scientific claims were thoroughly known by the members of the Academy, before which body his investigations had been brought. In the higher abstract sciences, Professor Jellett was second to none in this part of the empire, with the exception of one, who had retired, and he combined scientific attainments which were not often found in the same man. Dr. Stokes, in the absence of Dr. Russell, President of Maynooth, seconded the motion. Professor Jellett was duly elected by ballot. This election gives general satisfaction, as it has been felt for some time past that the scientific element in the Academy "has not," as the Earl of Dunraven expressed it, "taken the position that was its right."

Sir William Wilde then read a paper upon "*A Collection of Gold, Bronze, and Iron Antiquities Found in Excavations made for the Supplying of Gravel to the City.*" They were supposed to be of Scandinavian origin.

Dr. Apjohn then read a paper "*On the Proximate Analysis of Saccharine Substances.*" In this method, the author makes use of the optical and chemical processes, and thus quantitatively determines the amount of cane sugar, inverted sugar, and grape sugar in a given sample. An extended report of this paper will shortly be given in the Chemical News.

NOTICES OF BOOKS.

The Students' Chemistry; being the Seventh Edition of Household Chemistry, or the Science of Home Life. By Albert J. Bernays, Ph.D., F.C.S., Professor of Chemistry and of Practical Chemistry at St. Thomas's Hospital Medical and Surgical College, &c., &c. 1869. W. H. Allen and Co.

The well-known and popular work of Dr. Bernays has, in this new edition, been so completely altered and recast that it is, in point of fact, a new book. The experiment of altering the form of a work which has met with such marked favour from the public is a bold one, but we have no hesitation in predicting that, in the present instance, it will be entirely successful.

The book, in its present form, has no longer the popular and readable character that it formerly possessed; but, on the other hand, it is now what it never was before, a systematic and complete manual for students. It is very lucid in style and practical in matter. It contains a vast mass of fact simply and accurately stated, and bound together by just as much theory as is necessary for the understanding and remembering of it. The notes with which each chapter is headed are very clear and full, and will assist the labours of the student most materially. The author promises to devote a second volume to organic chemistry and to the theories of the science, and confines the present one to inorganic chemistry.

If this second volume is as good as the first, it will be a very useful book.

The Life and Letters of Faraday. By Dr. Bence Jones, Secretary of the Royal Institution. London: Longmans, Green, and Co. 1870. 2 vols. 8vo, with illustrations.

I.

We all remember the terse and pregnant account of the life of Faraday which appeared last year in the *Proceedings*

of the Royal Society, and which was written by Dr. Bence Jones. Here we had the broad outlines and main incidents of Faraday's great career; in the work before us we have the details of the picture, the delicate tintings, and careful finish—we have the details of Faraday's life, together with the more prominent incidents which were before known to us. The present "Life" is almost an autobiography; Faraday's letters are frequently quoted *in extenso*, and his manuscripts and journals have been freely consulted. Dr. Bence Jones had at one time hoped that the journals which Faraday wrote when abroad would have been published separately, when, as he remarks, "some portions of his biography would have been in his own handwriting; but it was thought undesirable to divide the records of the different parts of his life."

The principal facts connected with the life of Faraday have been previously enumerated in this journal and elsewhere; we shall assume, therefore, that it is unnecessary to bring before our readers any specially-connected biography, but shall rather content ourselves with noticing here and there some of the less-known phases of a life which we all admire so profoundly, and all so desire to emulate. The desultory character of this notice, therefore, arises from the belief that we have already in our minds, to a greater or lesser extent, a biography of the greatest natural philosopher of our epoch.

In reading Faraday's first letters to Mr. Abbott, which were written when he was twenty years old (1812), we cannot fail to be impressed, not by the amount of knowledge which he had acquired, so much as by the amount of thought which he had exercised. He had already read largely, and had not confined himself by any means to scientific works, but was evidently well acquainted with many of the classics of English literature. These letters are long, somewhat verbose, and decidedly more turgid in style than his later letters; in fact, we notice as we proceed a gradual assumption of that charming simplicity and clearness in writing which all his later compositions possess. An inflated style is the common error of young writers, and it is more often noticed at one certain period of a career, when the writer has rapidly and almost abnormally, so to speak, acquired learning and a taste for expressing his own ideas, than when it has been more gradually amassed, or to a less degree. Faraday had an early opportunity of lecturing, for he joined the City Philosophical Society in 1813, and it was the duty of each member, in rotation, to deliver a lecture. At this time, also, he was in the habit of meeting a few of his more intimate friends for purposes of mutual improvement; they "met of an evening to read together, and to criticise, correct, and improve each other's pronunciation and construction of language."

Shortly after his engagement at the Royal Institution, Faraday wrote several letters to his friend Abbott, on the subject of lecturing, and the qualifications which a lecturer ought to possess (pp. 70-79); these are well worthy the perusal of all who may be engaged in lecturing or science teaching; we find in them many of the precepts which Faraday followed through life, the observance of which made him the most lucid and elegant lecturer of our day. "A lecturer," he writes, "should endeavour, by all means, to obtain a facility of utterance, and the power of clothing his thoughts and ideas in language smooth and harmonious, and at the same time simple and easy. His periods should be round, not too long or unequal; they should be complete and expressive, conveying clearly the whole of the ideas intended to be conveyed. If they are long, or obscure, or incomplete, they give rise to a degree of labour in the minds of the hearers which quickly causes lassitude, indifference, and even disgust." . . . "A lecturer falls deeply beneath the dignity of his character when he descends so low as to angle for claps, and asks for commendation. Yet have I seen a lecturer even at this point. I have heard him causelessly condemn his own powers; I have heard him dwell for a length of time on the extreme care and niceness that the experiment he will make requires; I have heard him hope for indulgence when no indulgence was wanted; and I have even heard him declare that the experiment now made cannot fail, from its beauty, its correctness, and its application to gain the approbation of all."

During his travels on the Continent with Sir H. Davy, Faraday appears to have kept a careful journal; and this eighteen months of his life, although at times very distasteful, must have had a great effect on the formation of his mind and character, or rather in hastening or ripening his more prominent characteristics. It was, of course, a matter of much benefit to him (too often forgotten by those who speak of his self-education, without any of those advantages which the educated usually possess, &c.) to be in constant communication with one of the most brilliant and profound chemists in Europe, to work with him and for him, to notice the tone and manner of his thought, his treatment of questions of science, his mode of interrogating nature. It was advantageous to see other countries, study other languages, to examine scientifically, and with such a man as Davy, various natural phenomena and results of former phenomena not presented to us in these Islands. We find him one day working at the compounds of iodine (then recently discovered) in the laboratory of the Jardin des Plantes; on another, making the ascent of Vesuvius; he is now burning diamonds with Cosmo de Medici's great lens, now at a masked ball in a domino, or a spectator of the races in the Corso. During his tour, he appears to have had a good deal of time to himself, although, in certain respects, he did not find his post of amanuensis either a sinecure, or exactly what he expected as regards occupation.

Faraday returned to England in 1815, and now commenced his "early scientific training at the Royal Institution." He gave seven lectures during the year at the City Philosophical Society, on various subjects connected with chemistry, and he published his first paper ("An Analysis of Native Caustic Lime") in the *Quarterly Journal of Science*. In concluding his fifth lecture, he says:—"The philosopher should be a man willing to listen to every suggestion, but determined to judge for himself. He should not be biassed by appearances, have no favourite hypothesis, be of no school, and, in doctrine, have no master. He should not be a respecter of persons, but of things. Truth should be his primary object. If to these qualities be added industry, he may, indeed, hope to walk within the veil of the temple of Nature."

Five years later, Faraday, who was then in his twenty-ninth year, commenced what Dr. Bence Jones has well called his "higher scientific education at the Royal Institution." He had for seven years been the private assistant of Davy, and assistant in the laboratory and lecture-room. He had lectured with much success, both in the matter of speech and of experiment, and he had published thirty-seven notices and papers in the *Quarterly Journal of Science*. Yet, with all this, he did not publish the first of his "Experimental Researches on Electricity" for eleven years from this date; and this period between the end of his first seven years of science-study and the commencement of the publication of these great researches was the time of his higher education in science. Faraday had for many years kept a common-place book. In 1822, he commenced a new and more detailed note-book, which he called "Chemical Notes, Hints, Suggestions, and Objects of Pursuit." In this, we find mention of many researches, which were elaborated and published at a later date. For instance:—

"General effects of compression, either in condensing gases or producing solutions, or even giving combinations at low temperatures.

"State of electricity in the interior and on the surface of conductors, and on the surface of holes through them.

"Transparency of metals. Sun's light through gold-leaf. Two gold leaves made poles—light passed through one to the other."

At a later date, he wrote at the commencement of this collection of notes—"I already owe much to these notes, and

think such a collection worth the making by every scientific man. I am sure none would think the trouble lost after a year's experience."

In 1823, Faraday was elected a Fellow of the Royal Society; and other scientific honours now began to be offered him. He received, altogether, ninety-five honorary titles; and of these he said:—"One title—namely, that of F.R.S.—was sought and paid for; all the rest were spontaneous offerings of kindness and good-will from the bodies named."

In 1825, on the recommendation of Sir H. Davy, Faraday was appointed Director of the Laboratory of the Royal Institution; and one of his first acts was to invite members of the Institution to attend evening meetings in the Laboratory, at which Faraday showed new and striking experiments. From these meetings sprang the Friday evening discourses so well known to all of us, and the establishment of which probably, remarks Dr. Bence Jones, "saved the Institution."

Let us, now that we have arrived at the last year (1839) of Faraday's higher scientific education, pass in review some of his work, before passing to the commencement of that great series of researches which numbered more than fifteen thousand paragraphs, and was concluded in 1856.

He had already made notable researches on electro-magnetic motions, on the condensation of gases, on the manufacture of glass for optic purposes, and on the alloys of steel. He had discovered two chlorides of carbon, benzol and sulpho-naphthalic acid: and he had made various experiments on the diffusion of gases. Moreover, he had published sixty scientific papers, nine of which were in the *Philosophical Transactions.* Here, then, for the present, we will leave him, in his thirty-ninth year.

II.

The second volume of this work is divided into four chapters, of which the first treats of Faraday's "First Period of Electrical Research," included between the years 1831 and 1840, and extending to his forty-ninth year. The great discoveries of this period of his life were those of magneto-electricity and of definite electrical decomposition. So early as 1831, we find the germ of the idea of "lines of force"—an idea which pervaded all his succeeding philosophy. "By magnetic curves," he writes, "I mean lines of magnetic forces which would be depicted by iron filings." The first series of his "Experimental Researches in Electricity" was the result of ten days' labour, and was read on November 24th, 1831, at the Royal Society. The full course of these researches, together with the dates, has been so carefully noted by Dr. Bence Jones, in the notice of Faraday which appeared in the *Proceedings of the Royal Society* for last year, that it will be needless to enter into any detail here; moreover, the main facts of these great researches are more or less known to all of us, and require but little description. We may mention that the appendix to Chapter I contains an example of the notes from which Faraday lectured. On one side of a sheet of paper, he was in the habit of setting down the experiments, numbered and in order, and accompanied by divisions of the lecture-hour into intervals of minutes, varying from five to fifteen; on the other side, the notes of subject-matter were written, with figures corresponding to the numbered experiments.

The second chapter includes the years intervening between 1841 and 1844, and is entitled "Rest between the Periods of his Experimental Researches—Swiss Journal—Nature of Matter." The intense mental labour connected with the electrical researches had brought on attacks of giddiness and loss of memory, and for four years Faraday undertook but one research connected with electricity. He entirely rested during one year, even giving up lecturing at the Royal Institution; and he spent three months of this time in Switzerland. The journal which he kept during this period is full of interest, and shows us the character of the man apart from his science; and it may be here remarked that, although we are apt to study this character more in reference to Faraday's great efforts of scientific thought, it is equally worthy of minute study for other reasons, for the humanity, the gentleness, the love of truth and the consistency, which were such prominent characteristics of the man.

In 1843, the present Emperor of the French, at that time a prisoner in the Fortress of Ham, addressed several letters to Faraday on scientific subjects. We here find the Emperor appearing in an altogether novel light—viz., as the propounder of a new theory of the action of the voltaic pile, which was read to the Academy by M. Arago, but which does not appear to have been received with much warmth. The Emperor, however, shows that he possessed some knowledge of electricity, and his remarks and inferences are by no means superficial. In some of his experiments he required a galvanometer, but could not succeed in constructing one "parceque les aignilles aimantées furent toujours devées par l'attraction des barreaux de fer qui entourent mes fenêtres." Sometimes he seems to have thought of applications of voltaic electricity to purposes of war:—"*What is the most simple* combination," he asks Faraday, "to give to a voltaic battery, in order to produce a spark capable of setting fire to powder under water or under ground?"

The third chapter comprises the period between 1844 and 1855, and extends to Faraday's sixty-fourth year: it discusses "Later Period of Electrical Research—Discovery of the Magnetisation of Light—The Magnetic State of all Matter—Atmospheric Magnetism." The discoveries made during this second period of electrical research were published in the eleven series of "Experimental Researches in Electricity" included between the nineteenth and the thirtieth. Although the discovery of the magnetisation of light (which Sir William Thompson has designated "the greatest discovery of this century"), was among these discoveries, Dr. Bence Jones considers that, "great as these discoveries were, they will not at the present time rank with the three great discoveries of magneto-electricity, voltaic induction, and definite electro-chemical decomposition, which made the glory of the earlier period of the 'Researches in Electricity.'"

Here are some remarks drawn at random from various lectures given at the Royal Institution during the year 1845. Speaking of the fineness of gold wire, he said—"Four sovereigns' weight of pure gold could be drawn into a wire long enough to surround the globe." In a lecture on mercury, he said—"Lecture-room, with all its walls, floors, roofs, &c., from top to bottom, and full of people, if standing in a trough of mercury having the same base as the lecture-room, would only raise a column at the sides 17½ inches high." Of the voltaic battery, he said—"This instrument has done—is doing—more in developing the internal molecular powers of bodies, and the unity of the various forces in nature, than any other offspring of human thought." Speaking of evening lectures at the Royal Institution, he said—"As to popular lectures (which at the same time are to be *respectable* and *sound*), none are more difficult to find. Lectures which *really teach* will never be popular; lectures which are popular will never *really teach.* They know little of the matter who think science is more easily to be taught or learned than A B C; and yet who ever learned his A B C without pain and trouble?" In a letter published in the *Philosophical Magazine* for 1846, in which we find some of Faraday's boldest and grandest speculations, we have one of the many examples of the singular modesty and humility with which, even at the summit of his fame, he propounds a theory. "I think it likely," he says in concluding, "that I have made many mistakes in the preceding pages, for even to myself my ideas on this point appear only as the shadow of a speculation, or as one of those impressions upon the mind which are allowable for a time as guides to thought and research. He who labours in experimental inquiries knows how numerous these are, and how often their apparent fitness and beauty vanish before the progress and development of real natural truth."

In 1855, Faraday concluded his "Experimental Researches in Electricity." They had extended over a period

[English Edition, Vol. XX., No. 525, page 297; No. 526, page 308.]

of twenty-six years, and undoubtedly constitute his greatest and noblest work; the ultimate issue and result of the work it is impossible to estimate, each branch of it as left by him, nay, the smallest twig, may be transplanted, until a very forest is the result. It has stimulated, and will stimulate work; it admits of an infinity of applications; above all, it is a grand example of accurate work, combined with accurate thought, with method, with genius, with a refined manipulation, and a subtle mind. Let us glance at the main results of his electrical researches, in the order in which they occur. "The Induction of Electric Currents—The Evolution of Electricity from Magnetism—Terrestrial Magneto-Electric Induction—Identity of Electricity from Different Sources—Conducting-Power generally—Electro-Chemical Decomposition—Electricity of the Voltaic Pile—Induction of a Current on Itself—Static Induction—Nature of the Electric Force—Character of the Electric Force in the Gymnotus—Source of Power in the Voltaic Pile—The Electricity evolved by the Friction of Steam—The Magnetisation of Light, and the Illumination of Magnetic Lines of Force—New Magnetic Actions—The Magnetic Condition of all Matter—The Crystalline Polarity of Bismuth, and its relation to the Magnetic Form of Force—The possible relation of Gravity to Electricity—The Magnetic and Dia-Magnetic Condition of Bodies, including Oxygen and Nitrogen—Atmospheric Magnetism—Lines of Magnetic Force, and the Employment of Induced Magneto-Electric Currents as their Test and Measure—The Constancy of Differential Magne-Crystallic Force in Different Media—The Action of Heat on Magne-Crystals—The Effect of Heat upon the Absolute Magnetic Force of Bodies."

This magnificent work was done under conditions of penury; yet, "during a great part of these twenty-six years, the Royal Institution was kept alive by the lectures which Faraday gave for it." Faraday received, during the greater part of this time, £100 a-year from the Institution, and nearly £100 as Fullerian Professor. He kept account of his expenditure in research and apparatus literally to the uttermost farthing. Altogether, Faraday laboured for science for fifty-two years, one-half of which time was devoted to the "Experimental Researches in Electricity."

In June, 1862, Faraday gave his last Friday evening discourse at the Royal Institution. The following are the notes which he made for this his retirement from active duties:—

"Personal explanation,—years of happiness here, but time of retirement; Loss of Memory, and *physical* endurance of the brain.

"1. Causes—*hesitation and uncertainty* of the convictions which the speaker has to urge.

"2. *Inability to draw* upon the mind for the treasures of knowledge it has previously received.

"3. *Dimness*, and forgetfulness of one's former *self-standard*, in respect of *right, dignity*, and *self respect*.

"4. Strong duty of *doing justice to others*, yet inability to do so.

"5 *Retire*."

Who among those present will ever forget the intense enthusiasm which was exhibited at the conclusion of the lecture "On Platinum," nearly the last which Faraday gave? "I have desired to retire," he said, "as I think every man ought to do before his faculties become impaired; but I must confess that the affection which I have for this place is such that I hardly know when the proper time has arrived" No victor in the Olympian games, no conqueror ascending in triumph the Capitoline Hill, no *prima donna* in the height of her fame, ever received a more complete ovation.

"For thirty-eight years," says Dr. Bence Jones, "his lectures were the life of the Royal Institution. His singular power of making himself one with his audience was felt in his Juvenile Lectures, in his Theatre Courses, and in his Friday Evening Addresses." His great success as a lecturer may be attributed to his careful attention to strict rules; some of his earlier remarks on lecturing we gave in the first of these notices; the following rules were found among his notes:—

"Never to repeat a phrase.

"Never to go back to amend.

"If at a loss for a word, not to ch—ch—ch, or ch—ch—ch—, but to stop and wait for it. It soon comes, and the bad habits are broken, and fluency soon acquired.

"Never doubt a correction given to me by another."

In addition to this strict attention to rules, Faraday took lessons in lecturing in 1823, and again in 1825 and 1826, before giving his first course of lectures in the Institution.

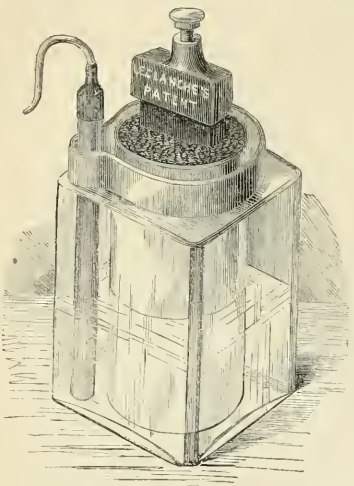
Dr. Bence Jones closes his admirable "Life of Faraday," by a statement of the chief of the characteristics of the great philosopher, and of the qualities which combined to render him so noble and so good. "As a philosopher, his first great characteristic was the trust which he put in facts. . . . His second was his imagination. It rose sometimes to divination, or scientific second-sight, and led him to anticipate results that he or others afterwards proved to be true." As a man, his first and greatest quality was his truthfulness; the second, his kindness; the third, his energy. "His religion was a living root of fresh humility, and, from first to last, it may be seen growing with his fame and reaching its height with his glory, and making him, to the end of his life, certainly the humblest, while he was also the most energetic, the truest, and the kindest of experimental philosophers. . . . His standard of duty was supernatural; it was not founded upon any intuitive ideas of right and wrong; nor was it fashioned upon any outward expediences of time and place; but it was formed entirely on what he held to be the revelation of the will of God in the written Word, and throughout all his life his faith led him to act up to the very letter of it."

Much has been said and written about the Faraday Memorial, and the proposition to erect a monument to him in St. Paul's cathedral is being actively advanced. Looking at his many and great works, and at this last record of him, full of his every-day thoughts and actions, we are tempted to repeat the hackneyed, but here infinitely appropriate, phrase, "*Si monumentum requiris, circumspice.*" Of Faraday himself we may truly say, "Exegit monumentum ære perennius." Yet there should be some mark of the popular esteem for such a man—and if it takes the form of a statue, it should be among the quick, not among the dead. It should be in the busy world and in the light of day, that they who pass by may stay, and read, and remember. Whoever enters St. Paul's, must feel the gloomy chill of the vast, silent edifice; all is dull and gloomy, and the surroundings recall to us obsequies, and friends mourning and the terrors of death. We would not have the statue of Faraday placed here; we would not wish to think of him with sorrow in our hearts and ashes on our heads; but we would have the memorial in our often view, and unencompassed by aught that brings feelings of gloom and unhappiness, in that we shall see him no more. To one who asked him, during his last years, how he was, he replied "Just waiting." Let us think of the old philosopher as he sat by his window at the close of life looking out upon the green trees and fields of Hampton, and delighting in the beauties of that Nature he had loved so fondly. He who had been so strong, so mighty to prevail, was now as a little child. The *lumen parum* of the great intellect which had penetrated the mysteries of Nature as few had ever done before, was flickering, and faint, and dim. *Nunc dimittis*,—"the sweetest canticle of all when a man hath obtained worthy ends and expectations"—is the thought which fills his mind; and as he gazes into the bright world without, the landscape fades almost imperceptibly from his sight, the voice of nature is hushed, and there comes a momentary darkness, the precursor of a perpetual light.

Treatise on the Leclanché Battery: Preceded by a Few Remarks on the Employment of Electrical Batteries in Telegraphy. London: The India Rubber, Gutta-Percha, and

Telegraph Works Co., Silvertown, Essex, and 100, Cannon Street, London.

In this pamphlet will be found a full description of the Leclanché cell, the main feature of which is that peroxide of manganese is used with zinc (amalgamated) and an aqueous solution of an alkaline salt, chloride of ammonium being preferred. The author states, and his statement is borne out by comparative experiments made with the Marié-Davy, Daniell, and Bunsen cells, that the Leclanché cell is preferable to any other. The cells are of three sizes, and the shape is shown in the accompanying cut; the smallest, with a porous pot 4·3 inches high, can accomplish an annual electric work which may be represented by 620 grains of copper reduced in the voltameter; the medium size, with a 6-inch porous pot, can reduce from 950 to 1000 grains, while the large size gives a work equal to 1500 or 2000 grains. We have ourselves



tried the cell, and can recommend its use to those who require galvanic electricity for telegraphic or other purposes.

Stereograms of Mars, with a Chart of Mars on Mercator's Projection, and Descriptive Remarks on the Stereograms. By R. A. Proctor, B.A., F.R.A.S. London: John Browning, 111, Minories.

We learn, from Mr. Proctor's remarks, that these stereograms are photographs from the globe of Mars which Mr. Browning constructed in the spring of 1868, the edges of the pictures being softened by hand. Viewed in the stereoscope, they give a singularly real and solid figure of the planet, and will not only afford the astronomer an opportunity of studying Mr. Browning's globe, but will also enable him to test the accuracy of his own observations. In producing these admirable stereograms, Mr. Browning has rendered another important service to the science of astronomy.

A Pharmacopœia, Including the Outlines of Materia Medica and Therapeutics, for the Use of Practitioners and Students of Veterinary Medicine. By Richard V. Tuson, F.C.S., Professor of Chemistry and Materia Medica at the Royal Veterinary College. London: John Churchill & Sons. 1869. Pp. 311.

The preface informs us that this work is designed for the use of practitioners and students of veterinary medicine. The agents are arranged in alphabetical order, according to the plan adopted in the "British Pharmacopœia," and are treated of under the following heads:—(1) Latin Pharmaceutical Name; (2) English Pharmaceutical Name; (3) Synonyms; (4) Compositions; (5) Mode of Preparation; (6) Characters and Tests; (7) Actions and Uses; (8) Doses; (9) Modes of Application; (10) Incompatibles; (11) Antidotes; (12) Preparations. This work bears evidence of the progress of scientific veterinary medicine in this country, which has hitherto in this respect remained backward as compared with France, Belgium, and Germany, and last, but not least, with the Netherlands, where scientific veterinary medicine has replaced rude and clumsy empiricism and quackery since the middle of last century. Veterinary medicine requires in its practitioners an amount of tact and spirit of patient observation, which in some respects makes it as difficult a practice as that of the diseases of infants and young children. The book of Professor Tuson is carefully written, and is a valuable addition to the literature of the subject. It will be valued not only in this country, but in many parts of Europe, as well as in that great portion of America where the English language is widely used and known. The composition of bodies is expressed in modern atomic weights, a table of which, together with a list of the old ones, is appended. At page 24 we meet with Aër Chlori; it would have been better to write chlorium gasiforme, or gas chlorium. Aër is strictly limited to the atmospheric air we breathe, and if it is desired to express the state of aggregation of chlorine at all, it is best, we think, to use the word *gas*, first introduced by the well known Van Helmont; instead of *aërial* we should prefer gaseous. We notice with pleasure the excellent tables of weights and measures of the metrical system, and the relation of these weights to the British and *vice versâ*. The index to veterinary medicines, *arranged according to their actions and uses*, has been very carefully compiled, and it is a very useful feature therein that the Greek and Latin words have been properly explained and their derivation made clear. The work is well executed, being printed in a very clear and legible type, and has been carefully revised, since we have not, on perusing it, met with any clerical errors. We recommend the book with pleasure, and hope that veterinary medicine may rise, as it ought, in the estimation of scientific, and especially medical men, who should consider that the veterinary physician may exercise, by the proper attendance to his calling, a great influence for the general public good. Seeing that that portion of *Police Science*, as Dr. H. von Mohl calls it, which is termed "Administration de la Sûreté et Salubrité Publique," is in this country an ill-defined and rudely digested chaotic mass, one cannot wonder that sufficient care has not been taken to assign to veterinary medicine its proper place and the social status it really deserves.

A Treatise on Asiatic Cholera. By C. Macnamara, Surgeon to the Calcutta Ophthalmic Hospital. London: John Churchill & Sons. 1870.

As may be expected from a medical man resident in the endemic area of cholera, this work contains very valuable information on a most difficult subject. From Section II., "On the Historical Account of Cholera," we learn what the Sanskrit writers have recorded on this subject; the translation given of an *historia morbi* by Susruta is highly interesting, and the more so to those who ever have witnessed patients attacked by Asiatic cholera, since they can hardly fail to observe the great resemblance this description bears to the reality; and from the vestige of a remote antiquity it would also appear that the disease has been in existence sporadically long before our era. The earliest notice of the existence of cholera in Hindostan, from the pen of a European, occurs in the "Lendas da India," by Gaspar Correa, in the year 1503; the entire chapter on the history of this disease is in every way interesting, and contains a great deal of

hitherto unknown, or, at least, not well collected information. The section on the geographical distribution of cholera, and that on the bearing of meteorological influences upon the spread of this disease is also very valuable; the etiology of cholera is lucidly treated of, and the theories of Messrs. Bayer Pettenkofer, Farr, and others, discussed in a clear manner. The value of the work is enhanced by the addition of several official reports, well executed maps, and statistical diagrams. As is usual with these publishers, this work is brought out in excellent style, and is a most valuable addition to the bibliography on this subject.

CORRESPONDENCE.

The Atomic Theory.

To the Editor of the Chemical News.

Sir,—Is it not surprising that, during the recent discussion on Professor Williamson's admirable paper on "The Atomic Theory," no one should have hit upon the simple link which unites the opposing doctrines?

Modern chemistry teaches us that the existence of matter as atoms and molecules is pretty nearly as certain as the existence of matter itself. It is only since that conception has been fully adopted, and by means of it, that chemistry has been raised into an exact science; and the idea involves the indivisibility of the ultimate atom.

On the other hand, mathematical science proves that such a thing as an indivisible atom having size and weight is simply an impossibility; and therefore people fear to accept the theory as absolute truth, but are compelled to use it grudgingly as a temporary expedient.

But why? both sides are correct. The atoms are the ultimate forms of matter *as we know it*, in the form of chemical elements; they cannot be divided, and remain those elements. But no one can affirm, or would think of doing so, that these elements are positively the ultimate forms of matter itself. On the other hand, there is a general feeling, justified by the remarkable relations between the atomic weights and properties of elements, that they are very probably compounds of yet simpler forms of matter, though their decomposition may not be possible to man. The doctrine of atomicity, showing us several centres of force in each atom, confirms this.

Hence, although the chemist can only deal with ascertained facts as a chemist, yet he loses none of his rights to the teachings of mathematics, and is quite entitled to believe that matter may be infinitely divisible and non-atomic in its ultimate essence, and yet be atomic and indivisible in the forms in which he has to deal with it.

May not the interplanetary ether be this ultimate form, and the tremendous actions of the sun, with its vast masses of hydrogen, be a stage of resolution of ordinary elements into this form, to be driven into space, and again condensed into ordinary matter, thus keeping up that circulation of existence which seems to be the fundamental system of Nature?—I am, &c.,

John T. Sprague.

Coal Dyes in 1818.

To the Editor of the Chemical News.

Sir,—I read in *Blackwood's Magazine*, for, June, 1818, p. 339, the following paragraph, which may, perhaps, be interesting to many of your readers:—

"*New Extracts from Coal.*—Dr. Jassmeyer, Professor of Chemistry in Vienna, has discovered the means of extracting from coals two hitherto unknown acids, a resin, a resinous gum, and other elements, which he has employed with surprising success to the purposes of dyeing wool, silk, hair, and linen, and has produced from them red, black, yellow, and various shades of brown and grey. Count von Chorinsky, President of the Aulic Chamber, and many other enlightened judges of these matters, were present at these experiments, and testified their entire approbation of this useful discovery."

Can any of our brother chemists inform us whether these products are known at the present day, and under what names?—I am, &c.

T. L. Phipson, Ph.D., F.C.S.,
Member of the Chemical Society of Paris.

Analytical Laboratory, Putney, S.W.
November 29, 1869.

The Meteoric Iron of Deesa.

To the Editor of the Chemical News.

Sir,—I find in the Chemical News (vol. xx., p. 274; *American Reprint, Feb., '70, page 99*), an abstract of the memoir published by *Cosmos* concerning the meteoric iron of Deesa.

Allow me to observe that the results indicated (except those which relate to the elementary composition of the metallic part) have not been obtained by M. Domeyko, but by myself.

I will add that the examination of the Deesa mass has led me to considerations which I believe to be new on the origin of meteorites.

The characters offered by this mass are such that it is impossible not to perceive in it a specimen of the first *meteoric eruptive rock* hitherto observed.

Consequently, the meteorite mass of Deesa permits us to affirm that meteorites, anciently in *statographical relations*, come from a globe, now broken up, which formerly revolved round the earth.

Finally, the consideration of *meteoric dykes* gives us the relative geological age of meteorites.

I shall be very glad if this letter can find a place in your most valuable journal.—I am, &c.,

Stanislas Meunier,
Docteur ès Sciences,
Aide Naturaliste au Museum.

23, Rue de Vaugirard, à Paris, Dec. 4, 1869.

Phosphamides.

To the Editor of the Chemical News.

Sir,—In your last number, among the "Chemical Notices from Foreign Sources," is an abstract of a paper by Schiff, in Beilstein's *Zeitschrift für Chemie*. In that paper he comments on one of mine, and re-asserts the existence of phosphotriamide, $P(NH_2)_3O$; but it is evident that his acquaintance with my communications to the Chemical Society on the various phosphamides is imperfect, and a statement of the different results of our experimenting may not be without its value.

Schiff's statement is that ammonia gas, passed over oxychloride of phosphorus, is capable of eliminating the whole of the chlorine, producing a triamide, thus:—

$$PCl_3O + 6NH_3 = P(NH_2)_3O + 3NH_4Cl;$$

and that this triamide may be separated from the chloride of ammonium by means of water, in which it is insoluble.

My statement is that I have never succeeded in replacing more than two equivalents of chlorine at any temperature, and that the amidated oxychloride thus produced is at once decomposed by water with the formation of pyrophosphotriamic acid, thus:—

$$PCl_3O + 4NH_3 = PCl(NH_2)_2O + 2NH_4Cl, \text{ and}$$
$$2(PCl(NH_2)_2O) + 2H_2O = P_2(NH_2)_3HO_4 + NH_4Cl + HCl.$$

But, where a high temperature has been employed in saturating the oxychloride with ammonia, the product of the action of water is not the triamic acid, but what I have called pyrophospho-pentazotic acid, $P_4N_5H_6O_7$.

Schiff's original view rested mainly on one determination

of phosphorus and nitrogen in his supposed phosphotriamide, which, however, gave numbers not very accordant with theory, while the phosphorus is nearly the same under either view. In his present note, he rests rather on the fact that the white powder, when heated *per se*, gives off ammonia without any chloride of ammonium, leaving PNO, and losing 36 per cent in weight.

My view rests on a large number of analyses of the two acids and their salts, and on the fact that, in my experiments, the oxychloride of phosphorus could never be made to increase in weight by the absorption of ammonia more than about 44 per cent, while a complete replacement of the chlorine would give 66·3.

It is evident that, under either view, ammonia without any chlorine must be given off when the white substance is strongly heated, and that phosphonitryl, PNO, is a probable result. I have already stated that pyrophospho-triamic acid, heated at low redness, gives off about 10 per cent of ammonia; and in an experiment, made for the purpose of determining how great a loss the substance would suffer when strongly heated, 16·85 per cent was all that could be obtained, and the black fused mass that remained in the tube was not pure phosphonitryl.

That Schiff should obtain a loss of 36 per cent would seem to indicate that he has produced some different compound from any of the acid amides, the formation of which has been my invariable experience.—I am, &c.,

J. H. Gladstone.

17, Pembridge Square,
Dec. 9, 1869.

LABORATORY NOTES.

AN EXPERIMENT

TO DEMONSTRATE INCREASE OF WEIGHT IN COMBUSTION.

There are two or three methods given in our text-books of demonstrating the increase of weight in combustion, and recently a novel one was described in the *Berichte der Deutschen Chemischen Gesellschaft zu Berlin* (Chemical News, vol. xx., p. 71; *American Reprint, October*, '69, *page* 240). This method consisted in burning iron filings attached to a magnet, the magnet and filings being hung over the pan of a moderately delicate balance. While preparing this experiment, another form of it occurred to me, and this I have found to answer admirably; it has, however, the disadvantage of requiring a supply of oxygen from a bag or gas-holder. The experiment is made thus:—A small patty-pan, or the lid of a tin box, is put in one pan of a balance and counterpoised; then a piece of iron wire, or a knitting pin, is placed on the pan, and this also weighed or counterpoised. The wire is now burnt before the oxy-hydrogen blowpipe, the patty-pan being held underneath the burning wire to catch the globules of iron oxide as they melt off. When the wire is burnt as far as practicable, the patty-pan with the globules of iron oxide and the portion of unburnt wire, is put into the scale-pan, and it will be found there is a considerable increase in weight, due to the oxygen which has combined with the iron.

C. J. Woodward, B.Sc.

Midland Institute, Birmingham,
December 20th, 1869.

SULPHURETTED HYDROGEN APPARATUS.

The following apparatus for the production of sulphuretted hydrogen will perhaps be found useful:—

It consists of a wide-mouthed bottle, A, fitted with a sound cork having two holes; through one hole a short glass tube (similar to the tube through which air is blown in a common wash-bottle) is passed, projecting into the bottle about ¼ inch.

A second smaller bottle, B,—one that can be lowered into A—is also fitted with a cork having two holes; through one a U-shaped tube is passed in such a manner that one end may touch the lower surface of the bottle A, and the other that of B, when one bottle is within the other. That portion of the tube which touches the lower surface of the big bottle should be of India-rubber, to prevent breakage.

The small bottle, with its cork and tube, should now be lowered into the bottle A, and through the remaining hole in each cork a tube is to be passed which shall project into the bottle B, about ½ inch. All the holes through which the tubes pass should be lined with India-rubber tubing to render them air-tight.

To use the apparatus, remove the large cork, and it will necessarily bring away with it the small bottle with its tubes. Fill the bottle B, about three-fourths with acid sulph. dil.; fix its cork. Now place in the bottle A some sulphide of iron in lumps. Lower the small bottle till it rests on the bottom of A. Fix in the large cork. If air be now blown through the tube projecting into the bottle which contains the acid, the contents will be forced through the U-shaped tube into the bottle A, where it will mix with the sulphide of iron, and the gas will be evolved, which will escape through the tube opening into A. When sufficient gas has been obtained, by blowing through the tube by which the gas is escaping, the acid will again be forced through the U-shaped tube into A, and all action will cease. Powdered sulphide of iron must not be employed, because it would be carried back with the acid into the small bottle, where the action would be continued.

C. J. H. Warden.

December 20th, 1869.

MISCELLANEOUS.

Operatic Fireworks.—The manner in which scientific discoveries are applied to utilitarian or, at least, to money-making purposes in this material age is well illustrated in a stage effect obtained in the performance of "Faust" at the Grand Opera in Paris. The scene represents *Mephistopheles* in the act of tapping a great wine-vat, whereupon the stream flows like liquid fire, and, falling into the wine-tub, bursts into flame. Usually, the wine stream has been represented by a "squib," but, in the present instance, by very different means. A vessel for containing water was furnished at one side with a horizontal adjutage, and at the other, immediately opposite the adjutage, with an opening closed by a glass plate. The stream issuing from the adjutage, describing a parabola in its course to the tub below, a beam of electric light, directed through the glazed opening and the contents of the vessel, follows the course of the jet from point to point, so that the entire jet becomes luminous and sparkling, the red colour of molten cast-iron being communicated by making the glass through which the light is transmitted to the water of an orange-red tint. The fireworks ignited in the tub to produce the flame previously mentioned are believed to have been set off by pellets of potassium, fired by contact with the water in the manner very generally known. A foreign contemporary suggests that a similar application might be made of the recent discovery by Professor Niekels—that, if commercial chloride of copper be mingled with sulphide of carbon holding phosphorus in solution, the mixture will only smoke, whereas the addition of a little ammonia (either gaseous or aqua ammonia) will insure its instantaneous bursting into flame. It was by means like this that, in the old times, sorcerers wrought their wonders to the astonishment alike of kings and people; but, in these days, the stage carpenter enables, for a few dimes, miracles to be witnessed for amusement that, a few generations ago, would have filled multitudes with awe.—*American Artisan.*

The Royal Society.—The annual meeting of the Fellows of this Society was held on the 30th Nov., at Burlington House. The President, Lieut.-General Sir Edward

Sabine, K.C.B., &c., delivered the inaugural address, in which he reviewed the progress which had been made in science during the year. The following gentlemen were afterwards elected on the Council for the ensuing year, viz.:—President—Lieut.-General Sir E. Sabine, R.A., K.C.B., D.C.L., LL.D. Treasurer—William A. Miller, M.D., D.C.L., LL.D. Secretaries—William Sharpey, M.D., LL.D.; George G. Stokes, Esq., M.A., D.C.L., LL.D. Foreign Secretary—Professor William Hallows Miller, M.A., LL.D. Other members of the Council—Frederick Currey, M.A.; Warren de la Rue, Ph.D.; Sir Philip de Malpas Grey Egerton, Bart., M.P.; Professor W. H. Flower, F.R.C.S.; William Huggins; John Gwyn Jeffreys; John Marshall, F.R.C.S.; Augustus Matthiessen, Ph.D.; Capt. Richards, R.N.; the Marquis of Salisbury, M.A.; C. W. Siemens; John Simon, F.R.C.S.; Archibald Smith, M.A.; Professor H. J. Stephen Smith, M.A.; Professor John Tyndall, LL.D.; and Professor A. W. Williamson, Ph.D. The Copley Medal was awarded to M. Victor Regnault, for his researches on the specific heat of gases and vapours, &c. A Royal Medal was awarded to Sir Thomas Maclear, the Astronomer-Royal at the Cape of Good Hope, for his measurement of an arc of the meridian. A Royal Medal was also awarded to Dr. Augustus Matthiessen, F.R.S., for his researches on the electrical and other physical properties of metals and their alloys. In the course of his remarks, the President said that Dr. Matthiessen's researches were distinguished, as well for their diversity as for their uniformly complete and trustworthy character, and referred, amongst others, to his investigation of the electric conducting power of commercial copper, which had resulted in very great improvement of the conducting power of the copper wire used in submarine telegraphy. After the meeting, the Fellows and their friends dined together at Willis's Rooms. The senior Fellow of the Royal Society is Sir John F. W. Herschel, Bart., D.C.L., who was First Wrangler and Smith's Prizeman at Cambridge in 1813, and was elected F.R.S. in the same year, being then only twenty-three years of age.

University of London.—*Second B.Sc. Examination (Examinations for Honours, B.A. and B.Sc. conjointly).*—Mathematics and Natural Philosophy: First Class. Richard Pendlebury, B.A. (scholarship), St. John's College, Cambridge.—Logic and Moral Philosophy: First Class. Matthew Robertson, B.A., New College; Walter William Rouse Ball, B.A., University College. Third Class. Arthur Clarke, B.A., Wesley College, Sheffield; Alfred Milnes, B.A., Manchester New College; James Greaves, B.A., private study; Frederick de Sola Mendes, B.A., University College; and Stephen Peter Hayes, B.A., Stonyhurst College, and Henry Keatley Moore, B.A., private study (equal). (*B.Sc. only*).—Chemistry: First Class. Alexander Muirhead, University College. Second Class. Charles Thomas Whitmell, St. John's and Trinity Colleges, Cambridge.—Geology and Palæontology: First Class. Charles Thomas Whitmell, St. John's and Trinity Colleges, Cambridge; Frederick Antony Potter, Royal School of Mines.—Zoology: First Class. Phineas Simon Abraham, Trinity College, and Royal College of Science, Dublin. Second Class. William Henry Johnson, University College.

The Quekett Microscopical Club.—We understand that Mr. Suffolk will repeat his course of lectures "On Microscopical Manipulation" in January, 1870. Gentlemen wishing for particulars can apply to the Secretary.

The Faraday Memorial.—The subscriptions to the Faraday Monument Fund, received up to Dec. 7, amount to £1400. The object of the fund is to provide a public memorial to Faraday, and the subscription from one person is not to exceed five guineas.—*Nature.*

Royal Institution of Great Britain.—The following are the arrangements for the Friday Evening Meetings before Easter, 1870:—

Jan. 21st. Professor Tyndall, LL.D., F.R.S., M.R.I.—"On Haze and Dust."

Jan. 28th. Professor Odling, F.R.S.—"On Professor Graham's Scientific Work."

Feb. 4th. Professor Ruskin, M.R.I.—"A Talk respecting Verona and its Rivers."

Feb. 11th. W. B. Carpenter, M.D., F.R.S., &c.—"On Temperature and Life in the Deep Sea."

Feb. 18th. William Kingdon Clifford, Esq., B.A.—"On Theories of the Physical Forces."

Feb. 25th. Colonel Sir Henry James, F.R.S.—"On the Results of the Excavations at Jerusalem, and on the Recent Survey of Sinai."

March 4th. E. J. Reed, Esq., C.B., Chief Constructor of the Navy.—"On Iron-clad Ships."

March 11th. Professor Sylvester, M.A., LL.D., F.R.S.—"On Chance."

March 18th. Peter W. Barlow, F.R.S.—"On the New Thames Tunnel."

March 25th. Professor Rolleston, M.D., F.R.S.—"On History of the Fourth, Fifth, and Sixth Centuries in England, as Illustrated by Researches into the Modes of Sepulture then Practised."

April 1st. Professor Roscoe, F.R.S.

April 8th. Professor Huxley, F.R.S.

Examination of Petroleum.—We have received from the committee of the Mineral Oil Association, to which Dr. Paul is consulting chemist, a statement of results obtained in the examination of 75 samples of petroleum and other kinds of mineral oil purchased in the ordinary course from retail dealers in the Metropolis, which show—(I.) That one-half of the oil represented by these samples is petroleum within the meaning of the Act (31 and 32 Vict., cap. 56); (II.) That it gives off inflammable vapour at a temperature below that specified by the Act as the minimum for ensuring safety in the stowage and sale of such oil; and (III.) That there is still a very general and habitual disregard of the provisions of the Petroleum Act. A portion of each sample of oil tested has been preserved at the office of this Association.

Uses of Aluminate of Soda.—The white opaque glass (semi-porcelain) of which the French gas globes are often made is manufactured in various ways. Hitherto kryolite (fluoride of aluminium and sodium) has been found to answer best for the manufacture of the opaque white glass, but it seems now destined to be supplanted by aluminate of soda. In the application of the latter, no fluorine compounds are evolved which act very much on the substance of the melting pots. 1 cwt. aluminate of soda is equal to $1\frac{1}{2}$ cwts. kryolite and 1-10th cwt. calcined soda in the mixture for making that kind of glass. The aluminate, as manufactured by kryolite-soda makers, is quite free from iron, which is never the case with kryolite itself. Other applications of the new manufacture are in dyeing and print works; as a mordant in soap making, where white and heavy soap is required; in precipitating dyeing lakes, &c. Very likely the applications of this product will become more numerous as it becomes better known.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the month, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note.—*All degrees of temperature are Centigrade, unless otherwise expressed.*

Comptes Rendus des Séances de l'Académie des Sciences, November 22, 1869.

This number contains the following original papers relating to chemistry and allied sciences:—

Spectrum of the Planet Neptune, and some Observations on Spectrum Analysis.—Rev. Father Secchi, S.J.—The author first refers briefly to his former observations of the spectrum exhibited by Uranus, and then mainly states that the spectrum of Neptune consists chiefly of three lines, or bands, placed near the green line, and that its light is entirely devoid of red; this is confirmed by the colour exhibited by the planet when seen through a telescope, which is a sea-green. The same author states that, though the night of the 14th of November last, at Rome, was not very favourable for observation of asteroids, on account of the somewhat cloudy sky, he had been enabled to notice more than 180 asteroids during one hour.

Heat given off by the Moon's Rays.—M. Zantedeschi.—From this paper, which is chiefly a review of what has been done by this and other authors in this direction, we learn that, as far back as the years 1685 and 1781, the Italian *savants*, Geminiano, Montanari, and Paolo Frisi, proved the existence of rays of heat emitted by the moon, by means of lenses and ordinary thermometers. The author refers to his observations made some twenty years ago, when he applied thermo-electric apparatus, as well as spirit thermometers and lenses, and obtained results fully confirming those made and recorded by the Italian *savants* just alluded to.

Colouration of Glass under the Influence of Direct Sunlight.—M. Bontemps.—The author, who is the managing director of the celebrated crystal glass works at Choisy le Roi, states, after referring to the observations on this subject made by the immortal Faraday, in 1824, and MM. Gaffield and Pelouze, in 1863 and 1867, that his observations lead to the following results:—Within three months after having been exposed to sunlight, the best and whitest glass made at St. Gobain is turned very distinctly yellow; extra-white glass (of a peculiar mode of manufacture) has become even more yellow, and gradually assumes a colour known as *pelure d'oignon;* glass containing 5 per cent of litharge was also affected, but far less perceptibly; crystal glass, made with carbonate of potassa (the other varieties referred to contain carbonate of soda), litharge, and silica, was not at all affected; English plate-glass, made by the British Plate-Glass Company, and exhibiting a distinctly azure-blue tinge, remained, also, unaffected. The author attributes this colouration, which begins with yellow and gradually turns to violet, passing through red *pelure d'oignon*, to the oxidising effects of the sun's rays upon the protoxides of iron and manganese contained in glass.

Physical Properties of Arable Soil.—M. Hervé-Mangon.—This paper is divided into the following sections:—Microscopical examination of arable soil; determination of the calorific properties of arable soil; condensation of gas in soils; diffusion of gas through soils; tension of aqueous vapour in soils.

Copper Mines of Lake Superior, and Discovery of Tin in the State of Maine, U. S.—M. Jackson.—In the shape of a letter, written by the author to M. Elie de Beaumont, the author states that, in June last, there was found in the Phœnix copper mine, near Lake Superior, a mass of native copper measuring $65 \times 32 \times 4$ feet, weighing 1000 tons, and valued at 400,000 dollars. In some parts, this mass has, instead of its average 4 ft, 7 ft. thickness. As to the site where the tin ore has been discovered, the author states that he received a sample, sent to him from Winslow by a Mr. Moore, and that, on analysis, he (M. Jackson) found the ore to yield, in its crude state, 46 per cent of pure tin, and after washing, about 75·5 per cent. There exist some forty mineral veins containing the ore, and these veins are workable.

New and Important Works.—M. E. de Beaumont.—In his capacity as one of the perpetual secretaries, the author calls particular attention to two works—viz., that of the illustrious geologist and vice-president of the Belgian Senate, M. Omalius d'Halloy, "On the Human Races, or Elements of Ethnography," which is highly eulogised for its clear and distinct language and simplicity of reasoning; and the work of M. Burmeister, "The History of Creation," which has now reached its seventh edition, and is translated into no less than seven different languages, the original being written in German. The eminent perpetual secretary above named speaks of this work as a most masterly exposition of scientific truths placed before the public in a very attractive and pleasant shape.

Revue Hebdomadaire de Chimie, November 11, 1869.

The number contains the following original matter:—

Powders to which Aniline Colours are Added.—M. Mène.—It appears that there are met with in the trade, a series of powders, of comparatively inert nature, with which aniline colours are incorporated. The author says—These substances are chiefly starch, which has been made to absorb alcoholic solutions of the different aniline dyes, and the coloured powders so obtained are employed in the manufacture of coloured printing-inks. As an improved method of the manufacture of such powders (the author says), I employ the following process:—Dissolve, in ½ a kilo. of 95 per cent alcohol, 10 grms. of copal resin and 1 grm. of magenta red; filter the solution, and incorporate therewith, afterwards, so much dry starch as will form a friable uniformly-coloured mass. The mixture is dried in a properly-constructed drying apparatus, and next ground to powder. When a violet tinge is desired, only half the quantity of magenta-red is applied, and the other half replaced by ultramarine. The addition of copal has the effect of fixing the colouring matter to the starch.

A New Kind of Burette.—M. Gondolo.—This piece of apparatus consists essentially of the graduated tube generally applied; but it is improved upon in the following manner:—The internal conical opening at the bottom is shut by a very carefully-ground-in glass plug of conical shape. To this plug is soldered a glass rod, running through the length of the graduated tube, and passing through a cork at the top; in the cork, a spring has been ingeniously placed, in such a manner as to force the glass rod down, and keeping the plug tightly fitting the opening at the bottom. When it is desired to use the burette, which is, of course, firmly fixed in a proper stand, the hand of the operator lifts the end of the glass rod, which projects outside the cork, for a moment, and, on releasing the action of the hand, the plug is shut again by the action of the spring. Provision is made for the admittance of air, of course; and, according to the author's statement, this kind of burette is now very generally in use in France and Germany, and giving great satisfaction to all who use it.

Detection of Adulterations of Soft Soap.—M. Arbelier.—Soft soap is frequently adulterated by the addition of from 20 to 25 per cent of raw starch, with the view of giving to the soap an appearance which, if genuine, is due to solid stearates formed therein. The microscopic investigation will, of course, readily detect this fraud; but if it is required to apply a chemical test, the author states that 10 grms. of the sample of soap should be taken and dissolved, without the application of heat, in alcohol of 85 per cent; the soap, if unadulterated, will be readily dissolved, leaving no residue. If any residue is left, it can be tested by the well-known methods for starch, as well as for other impurities. Lime is sometimes present.

Trade in Flowers Used for Perfumery.—M. Contet.—From this paper we abstract the following:—In order to obtain, by distillation, 1 kilogramme of the undermentioned essential oils, the annexed quantities of parts of plants are required:—Neroli, 100 kilos. of orange blossom; roses, from 10 to 30,000 kilos. of petals of roses; petitgrain, about 500 kilos. of the leaves of the orange-tree; mint, about 500 kilos. of leaves; lavender, about 250 kilos. of flowers; geranium, about 2,000 kilos. of the leaves. The extent of the trade of some of these articles may be inferred from the fact that the neighbourhood of Nice alone produces annually a

value of £8000 of one single kind of flower, the well-known sweet-smelling Nizza violet. The leaves of the orange-trees are valued at about 20 francs per 100 kilos. Among the perfumes more generally known in Southern than in Northern Europe belongs the *cassies* (*Acacia farnesiana*), frequently used by both French and Spanish ladies to impart a pleasant perfume to their linen.

November 18, 1869.

Preparation of Gilders' Glue.—M. Totin.—Rabbit skins are cut up to shreds as small as vermicelli, and boiled for some time on a water-bath after previous addition of a sufficient quantity of water. The fluid is separated from the portion of the skin insoluble in water by passing through a sieve; and to the fluid, while yet hot, is next added a solution of 100 grms. of sulphate of zinc, and 25 grms. of alum, previously dissolved in pure and boiling water. The mixture is thoroughly stirred up, and again filtered through a fine sieve; after this, the clear fluid is poured into a suitable vessel, and left to solidify, which takes place after twenty-four hours in winter and forty-eight in summer. When the solidification is complete, the gelatinous mass is cut up into oblong squares and dried, as is usual with glue. When required for use, the dry glue should be soaked first, for about ten hours, in cold water, and next melted by the aid of a water-bath. 1 kilo. of this dried glue yields a thick solution with from 8 to 10 litres of water.

Preparation of Albumen from Blood.—M. Dolfus-Galline.—The increasing demand for albumen, especially for the use of calico-printing (fixing of pigment and other colours), has at various times led to attempts to obtain a supply of this article from the blood of slaughtered oxen and sheep. The author of this paper describes at great length a process invented by him, and actually in operation on the large scale at the *abattoirs* of Dornach, France. The process is based upon the fact of the coagulation of the so-called cruor of the blood, and its separation from the serum thereof, the latter yielding, by cautious management, a dried albumen which can be applied instead of egg albumen for clear and bright colours, while the former may be manufactured into an albumen suitable for dark pigments. 10 litres of serum yield 1 kilo. of dry colourless albumen, and the blood of two-and-a-half oxen yields just sufficient serum to obtain this quantity of albumen; the blood of ten sheep and seventeen calves also produces the same quantity of dry albumen, viz., 1 kilo.

Gas Aerifuge.—M. Rouillé.—The author describes and elucidates by a woodcut an apparatus suitable to manufacture gas from the essence of petroleum. In reality, the gas is simply atmospheric air saturated with the vapour of that essence and conducted through pipes. From experiments which are described in this paper, and which appear to have been fairly and scientifically conducted with impartiality, this mode of gas-lighting is fully 21 per cent cheaper than the use of coal-gas, in Paris, for equal illuminating power. The vapour-gas, however, yields a better light; its illuminating power is far greater, for equal consumption, than that of coal-gas, and the products of its combustion are completely free from sulphur and ammonia. The apparatus are simple and efficient, and may be inspected in operation at No. 211, Rue Lafayette, Paris, where, on every Tuesday and Friday evening, the public are admitted to a room purposely fitted up for photometrical and other experiments.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, No. 201, September, 1869.

This periodical contains the following papers and communications bearing upon chemical subjects:—

Researches on the Bleaching of Woven Tissues.—M. Kolb.—There exists in the linen fibre, along with cellulose, two distinct substances—one of these is pectic acid, which is readily and very completely eliminated by alkalies; the other is a colouring substance, which is generated during the roating of the flax, giving thereto a greyish hue, and resisting the solvent action of all known solvents, and only separable from the cellulose by dissolving the latter in the ammonio-copper solution. While the quantity of pectinic products amounts in flax to from 15 to 36 per cent, this greyish matter is present therein in infinitesimal small quantity. Chlorine and hypochlorites discolour this substance, but do not dissolve it; perfect bleaching consists, therefore, in two operations—(1) elimination of all yellow colouring matter by means of alkali; (2) oxidation, and hence decoloration, of the greyish matter, which does not, however, as is generally assumed, thereby become soluble in alkalies. The author proposes the use of dilute liquid ammonia as the best so-called antichlorine, and also because it is simultaneously antacid.

Preservation of Butchers' Meat.—M. Gorges.—The process in use on the large scale by the author at Monte-Video is, briefly, as follows:—The meat, in pieces weighing from 2 to 50 kilos., is placed in a mixture of water (85 per cent), the rest being hydrochloric acid, glycerine, and bisulphite of soda. After having been steeped for some time, the pieces are taken out and dusted over with finely-powdered dry bisulphite of soda, and then packed in air-tight boxes filled as full as possible. In this state, the meat keeps fresh any length of time, and becomes perfectly fit for use—equal to fresh butcher's meat—by steeping for a short time in water to which vinegar has been added, and afterwards exposure to air. The author manufactures, at the place above named, an excellent extract of meat, which can be sold in Europe at 6 francs per kilo.; the price of the preserved meat, of which it would be easy to supply to London and Paris daily over 10 tons, is from 50 to 60 centimes per kilo.

Purification of Sewage Water.—M. Durand-Claye.—From this lengthy paper we quote the fact that the mother liquor of the manufacture of sulphate of alumina clarifies and purifies the liquid in question better than any other substance tried by the authors on the large scale. The expense only amounts to 0·0125 franc per cubic metre of fluid (rather more than 35 English cubic feet).

Cosmos, November 20, 1869.

This number contains the following original matter relating to chemistry and allied sciences:—

Analysis of the Meteorite of Deesa.—M. Domeyko.—This meteorite was observed in Chili, near Santiago, and the author, Inspector-General of Mines to the Republic alluded to, gives, in a lengthy paper, the following chemically-interesting particulars:—The metallic portion of the stone has, at 11°, a specific gravity of 7·51, and consists, in 100 parts, of—Iron, 87·17; nickel, 8·75; insoluble silicate, 2·40; phosphuret of iron and nickel, 1·42. The stony part of this meteorite is exceedingly hard, scratches glass readily, and is not scratched by hardened steel, and assumes a brilliant polish. The sp. gr. of this substance is, at 12°, = 3·589; it contains 12·62 per cent of nickeliferous iron. 58·45 per cent is soluble, and 41·55 per cent not soluble in HCl. The insoluble portion consists of—Silica, 18·64; magnesia, 17·89; protoxide of iron, 5·71; traces of soda and alumina; nickeliferous iron, 12·62; troilite, sulphide of iron of meteorites, a peculiar protosulphide of iron, 5·01 (we quote the original exactly, but the total adds up to 59·87, as it is given there). The portion soluble in acid consists of—Silica, 20·79; magnesia, 9·70; protoxide of iron, 6·99; lime, 1·45; trace of soda; alumina, 2·27; peroxide of iron, 0·41; with traces of sesquioxide of chromium, phosphorus, and carbon. The insoluble portion approaches the composition of the peridote, and the soluble portion that of pyroxenic minerals.

Lectures at the Conservatoire des Arts et Metiers, Paris.—While the requirements of technical education are often discussed, many of our readers will, perhaps, be interested with the following list: Geometry applied to arts; descriptive geometry; mechanics applied

to arts; civil architecture; applied natural philosophy; applied chemistry; industrial chemistry; the chemistry of dyeing, glass making, and ceramic art; agricultural chemistry; lectures on the theory of agriculture; agricultural engineering; spinning and weaving; political economy and industrial legislation; industrial economy and statistics. Among the lecturers are MM. Becquerel, Peligot, Tresca, Payen, de Luynes, Boussingault, &c.

Mineral Substances Applied for Staining Glass and Porcelain.—M. Meunier.—The colours applied to porcelain and glass are in reality coloured glasses, which are burnt into the mass of the white glass or china. As regards the latter, in most cases, after it has been glazed, since most of the substances used as colouring matter do not stand a very strong heat (technically, in French, *grand feu*)—that is to say, the heat at which the porcelain is fired—the burning-in of the colours is effected in muffles. As colouring matters for porcelain are used—Peroxide of iron for red (brick), brown, violet, yellow, and sepia; oxide of chromium for green; oxide of cobalt and nitrate of protoxide of cobalt and potassa for blue and black; oxide of uranium for orange and black; oxide of manganese for violet, brown, and black; oxide of iridium, for deep-toned black; oxide of titanium for yellow; oxide of antimony for yellow; black oxide of copper for green, and red oxide (suboxide) of copper for red; chromate of lead for yellow; chromate of baryta for yellow; chloride of silver for red; chloride of platinum, and chloride of platinum and ammonium, for steel-colour (in fact, metallic platinum); purple of cassius for purple and rose-red colour. Only the following substances stand, without deterioration or volatilisation, the highest heat of the porcelain furnace (they are *couleurs grand feu*): —The oxides of uranium, cobalt, chromium, manganese, iron (peroxide), and titanium. Most of the substances mentioned are not used as such in pure state, but require either to be mixed very intimately, often by a previous ignition with various fluxes, or, also, with other substances, to produce the required hue and shade of colour. The chemistry of the colouring matters required by the artists who paint on porcelain is one of the most difficult and intricate portions of the application of that science to art.

Bayerisches Industrie und Gewerbeblatt, September, 1869.

Among the official announcements in this number, we notice the *series lectionum*, or programme of the winter session of the Royal Polytechnic School at Munich, containing the following sections:—Mathematical sciences; natural sciences; engineering and architectural science; mechanico-technical science; chemico-technical sciences; general class, including modern foreign languages; drawing class.

Police des Mines et Carrieres.—An excellent model of the rules and regulations to be observed for the safety of the working of mines and quarries.

Central Air-Heating Stove.—M. Broc.—There is added to this excellent paper a series of drawings. The stove is designed for heating large buildings, as well as private dwellings, keeping up throughout every part thereof a uniform heat at very little expense.

Precautions Required to be taken by those who Work with Mercury.—Dr. Pappenheim.—This paper is the first instalment of a lengthy memoir on the subject of the volatility of mercury, and on tests for its presence in the atmosphere, especially of workshops. It appears that living plants are so highly sensitive to vapors of mercury that they are the best tests for the purpose of detecting even very minute quantities of the vapors of that metal, especially when the plants are young. The effect of mercury upon plants is the decolouration of all the green parts, especially the leaves.

Utilisation of Scraps of Tinned Iron.—M. Bock. —The scraps are placed in a tank made of stout sheet iron. To 1 cwt. of scraps, 6 lbs. of flowers of sulphur, 10 lbs. of caustic soda, and a quantity of water are added, and the mixture brought to ebullition by means of steam, introduced into the tank by means of a suitable pipe. The boiling is continued for about half an hour; the liquor is filtered, evaporated to dryness, and ignited with access of air. The ignited mass is lixiviated with water, yielding stannate of soda and sulphate of soda, which are separated from each other by their different degree of solubility; both salts crystallise.

Neues Jahrbuch für Pharmacie, von Dr. F. Vorwerk, September. 1869.

This number contains the following original papers and communications:—

Some Little-Known Poisonous Mexican Plants belonging to the Order of Compositæ.—Dr. Huseman.—It appears that the plant known as *Itz cuimpatli, Yerba de Pueblo, Senecio canicida*, has been submitted to a chemical investigation by the Mexican chemist, De la Loza; he detected a peculiar organic acid, which he called senecic acid. This acid should, according to this chemist, possess poisonous properties; it forms, with potassa and ammonia, deliquescent salts; neither the acid itself, nor its alkaline salts, are precipitated by the soluble salts of lime, magnesia, mercury, silver, copper, and platinum. The acid is soluble in alcohol, and is obtained by treating a decoction of the plant with acetate of lead and removal of the excess of lead by means of dilute sulphuric acid; the fluid so obtained, after filtration, is evaporated to the consistency of a syrup, and left standing for a few days. The acid separates in small, but deliquescent crystals; these are collected, and purified by treatment with strong alcohol. The acid and its salts are very poisonous; but the plant and its alcoholic extract are used in Mexico as a powerful febrifuge and anthelmintic.

Contributions to the Search for, and Detection of Blood-Stains.—M. Hirsch.—There is nothing in this paper which is not well known to all who, in their capacity as forensic chemists, may have to deal with this subject.

Testing Antimony for Arsenic by the Moist Way. —M. Rump.—The author states—During the latter end of last year, on the occasion of the inspection of apothecaries' shops in Prussia, a quantity of tartar emetic was found to contain arsenic; as a consequence thereof, a report was made to head-quarters, at Berlin, and a rigorous inquiry and investigation set on foot by order of Dr. de Mühler, as minister for medical affairs and police (*medizinal polizei*). The methods of testing for arsenic, when mixed up with antimonial preparations, were carefully considered, and the following method of testing, due to the researches of Mine Inspector Strohmeyer, adopted:—2 grms. of the suspected tartar emetic are reduced to a fine powder and dissolved in 4 grms. of pure hydrochloric acid (sp. gr., 1·124). The glass vessel wherein this solution is made ought to be narrow, and capable of being well closed, and of sufficient size to contain an additional quantity of at least 30 grms. more of hydrochloric acid. A quantity of pure hydrochloric acid should be thoroughly saturated with sulphuretted hydrogen gas, and of this acid a quantity of at least 30 grms. is added to the solution of the tartar emetic. The glass vessel containing the solution is well corked, and after having been shaken up, set aside; the turbidity which at first appears soon subsides (if it does not do so, it is due to the too great saturation of the HCl with HS, and should be remedied by the addition of some pure HCl). If no arsenic is present at all, the liquid remains perfectly colourless; but the slightest trace of arsenic gives rise to a yellow colouration, and very soon after to a perfectly perceptible pure yellow precipitate of sulphuret of arsenic.

Zeitschrift für Chemie von Beilstein, No. 20, 1869.

On Phosphamides.—M. Schiff.—After briefly referring to his former experiments on this subject, and com-

menting, in a few words, on Dr. Gladstone's treatise on the action of ammonia upon oxychloride of phosphorus, the author says—When perfectly dry ammonia gas is brought into contact with oxychloride of phosphorus, so much heat is at first set free that it is necessary to moderate the action considerably; but it is not possible to eliminate the whole of the chlorine, unless the product first obtained be repeatedly treated with ammonia. The chloride of ammonium can be removed by hot water, since neither that fluid, nor, also, dilute acids, have any decomposing effect upon the triamide thus formed. When phosphotriamide is heated without access of air, it is converted into monophosphamide, NPO, the loss of weight amounting to about 36 per cent. It is clear that only ammonia is disengaged, and no vapours of chloride of ammonium are detected at all, which would certainly make their appearance if a chlorinated amide were dealt with. When phosphoric acid is considered as—

$$P\left\{\begin{matrix} O.OH \\ OH \\ OH \end{matrix}\right.$$

and the oxychloride of phosphorus as—

$$P\left\{\begin{matrix} O.Cl \\ Cl \\ Cl \end{matrix}\right.$$

the meaning is that one of the atoms of chlorine has a different chemical function than the two other atoms; and it is just possible that that very one atom is less readily acted upon than the rest. When pentachloride of phosphorus is suffered to act upon aniline, a rather violent reaction takes place; but, with careful management, a whitish-coloured substance, insoluble, and thereby undecomposable in cold water and dilute acids, is obtained; when, however, this substance is boiled with water, it is split up, and phosphate of aniline is among the products of decomposition. The original product is phosphodianilide—

$$N_2\left\{\begin{matrix} PO \\ 3C_6H_5 \end{matrix}\right.$$

and its formation is represented as follows:—1. First action of aniline and pentachloride of phosphorus—

$$PCl_5 + 3C_6H_7N = N_2\left\{\begin{matrix} PCl_2 \\ 3C_6H_5 \end{matrix}\right\} + NH_4Cl + 2HCl.$$

2. On being next treated with water—

$$N_2\left\{\begin{matrix} PCl_2 \\ 3C_6H_5 \end{matrix}\right\} + H_2O = N_2\left\{\begin{matrix} PO \\ 3C_6H_5 \end{matrix}\right\} + 2HCl.$$

Cyantoluylen.—M. Irelan.—The author has investigated the behaviour of chlorotoluol-sulphate of potassa towards cyanide of potassium. When an intimate mixture of these salts is heated, a sublimate is obtained, exhibiting, after recrystallisation from alcohol, a solid substance forming needle-shaped crystals composed according to the formula—

$$C_{\alpha}H_6N_2 = C_7H_6\left\{\begin{matrix} CN \\ CN \end{matrix}\right.$$

On being boiled with a solution of caustic potassa, ammonia is given off, and if, afterwards, sulphuric acid is added, a dicarbon acid (*dicarbonsäure*) is precipitated, which acid is, in all probability, uvitinic acid. Dichlorotoluolsulpho acid yields, when submitted to the same treatment, a cyanised compound.

Behaviour of Epichlorhydrine towards Neutral Sulphate of Potassa and Cyanide of Potassium.—M. Pazschke.—On mixing 1 molecule of epichlorhydrine and 1 molecule of K_2SO_4 in concentrated aqueous solution, and boiling the mixture, a deep yellow-coloured, acrid-smelling fluid was obtained, which solidified on cooling, yielding a crystalline compound, which, after having been repeatedly recrystallised, yielded a salt, $C_3H_5S_2O_7K_2 + 2H_2O$; that is to say, disulphoglycerinate of potassa. The reaction of neutral sulphate of potassa upon epichlorhydrin is rather complex, and exhibits two different stages:—

$$1.\ \left.\begin{matrix} CH_2 \\ CH_2O \\ Cl \end{matrix}\right\} C + 2\left(\begin{matrix} KO \\ KO(SO) \end{matrix}\right) = \left\{\begin{matrix} CH_2K \\ CH_2O \end{matrix}\right\} C\left(\begin{matrix} SO_2 \\ SO_2 \end{matrix}\right)\left.\begin{matrix} OK \\ OK \end{matrix}\right\} + KCl.$$

$$2.\ \left.\begin{matrix} CH_2K \\ CH_2O \end{matrix}\right\} C\left(\begin{matrix} SO_2 \\ SO_2 \end{matrix}\right)\left.\begin{matrix} OK \\ OK \end{matrix}\right\} + H_2O = \left\{\begin{matrix} H_2 \\ CH_2O \end{matrix}\right\} C\left(\begin{matrix} SO_2 \\ SO_2 \end{matrix}\right)\left.\begin{matrix} OK \\ OK \end{matrix}\right\} + KOH.$$

When 20 grms. of epichlorhydrine were gently heated along with an aqueous solution of cyanide of potassium (15 grms. KCy, and 60 grms. H_2O), a rather violent reaction sets in; but, with proper management, a crystalline compound is obtained, which is readily dissolved by water and alcohol, but sparingly by ether; this substance is composed according to the formula C_4H_8NO.

Identity of Dichlorhydrine obtained from Glycerine and Epichlorhydrine.—The author has compared dichlorhydrine, prepared by passing hydrochloric acid gas into a mixture of four parts of glycerine and three parts of glacial acetic acid, with the dichlorhydrine prepared by passing hydrochloric acid gas into epichlorhydrine. The former boils at from 176° to 177° and has a sp. gr. of 1·366 at 17·5°; the latter boils at from 175° to 176°, and has, at 17·5°, the very same density as just mentioned. They are both equally soluble in water.

Dicyannaphthaline.—MM. Baltzer and Merz.—When dipotassium-disulphonaphthalate is submitted to distillation with excess of cyanide of potassium, a fluid is obtained which solidifies in the neck of the retort. This crude substance contains two dicyannaphthalines, of different solubility in alcohol. The more readily soluble of the two exhibits, after having been purified, a silky-looking, needle-shaped, crystalline mass, devoid of taste and smell, and fusing at 181°; this substance is completely decomposed at about 200°, and the action of either aqueous solution of caustic potassa or hydrochloric acid yielding, in each instance, naphthalin-dicarboxylic acid, a beautifully crystalline compound. The other dicyannaphthaline, far less soluble in alcohol (boiling only), fuses at 260°, is a crystalline compound, and undoubtedly identical with a substance obtained by MM. Darmstädter and Wichelhaus from dinaphthalin-disulpho acid.

Isomeric Cresoles and their Derivatives.—MM. Engelhardt and Latschinoff.—This lengthy memoir opens with an introduction reviewing the labours of so large a number of scientific chemists who have experimented on this subject, that their names alone would fill a too considerable space. Of the paper itself, we can only give the titles of the headings of its different sections: Isomeric toluolsulpho acids, $C_7H_8(HSO_3)$; α and β toluolsulpho salts; isomeric cresoles, C_7H_8O; α cresole; α benzoyl-cresole, $C_7H_7O(C_7H_6O)$; α ethyl-cresole; α cresol-sulpho acid; α cresol-sulpho potassium, $C_7H_6(KSO_2)OH + 2H_2O$, and a series of similar salts of various bases; α cresol-disulpho acid; α cresol-disulpho-potassium—

$$C_7H_6(KSO_3)_2OH + 3H_2O;$$

β cresole, C_7H_8O; β benzoyl-cresole; β cresol-sulpho acid; γ cresole, C_7H_8O; γ benzoyl-cresole, $C_7H_7O(C_7H_6O)$; γ ethyl-cresole; γ cresol-sulpho acid; isomeric cresotinic acids, $C_8H_8O_3$; isomeric toluylic acids. The memoir is an abstract from a very lengthy paper published in the Russian language, and is so full of formulæ and references to different papers published on this subject that it is not possible to enter into more details here.

Some of the Products of Decomposition of Trichloromethylsulphurous Acid.—M. Loew.—When trichloromethylsulphonbromide is submitted, in alcoholic solution, to a temperature of about 110°, while enclosed in a sealed tube, and the contents of the tube are next diluted with water, a heavy oil is separated, while the supernatant liquid contains free sulphurous acid; this reaction takes place according to the following equation:—

$$\underbrace{(CCl_3)[SO_2]Br}_{\text{Trichloromethyl-sulphonbromide.}} = \underbrace{CCl_3Br}_{\text{Carbontrichloro-bromide.}} + SO_2.$$

[English Edition, Vol. XX., No. 523, pages 275, 276.]

Along with the sulphurous acid, a small quantity of trichloromethylsulphonic acid is detected. Carbontrichlorobromide boils at 98°, and is, when passed through a dull red-hot combustion tube, decomposed into bromine and solid chloride of carbon. The author did not succeed in obtaining the analogous iodide; neither did he obtain a trichloromethyl-sulpho urea. While attempting to prepare dichloromethylsulphon, by submitting trichloromethylsulphinate of sodium to destructive distillation, according to the formula—

$$(CCl_3)[SO]ONa = NaCl + (CCl_2)[SO_2],$$

a very small quantity of that substance was obtained; but the reaction went further, and other substances, among which, perchloride of ethylen, were obtained, this reaction being represented by—

$$2((CCl_2)[SO_2]) = 2SO_2 + C_2Cl_4.$$

Action of Direct Sunlight upon Iodide of Potassium.—M. Loew.—A solution of iodide of potassium is, even when kept in well-closed bottles, slowly decomposed by the action of daylight, and assumes a somewhat yellowish tinge, due to free iodine. The author filled a number of glass tubes for about from one-half to three-fourths of their capacity, with a solution of iodide of potassium, and, after having sealed these tubes, exposed them to direct sunlight. Another set of tubes were likewise filled with the same solution, but all air was expelled, and the tubes sealed during and after the solution had been boiling for a considerable time. These tubes were also exposed to the action of direct sunlight; after three and four months' exposure, the tubes and contents were examined; those wherein no air at all was left were found to be perfectly colourless, no decomposition of the contents having taken place. As regards the other tubes, the following results are noticed:—(1) Under the influence of light, the oxygen of the air decomposes iodide of potassium, iodine in small quantity is set free, while hydrate of potassa is found in the liquid. (2) This decomposition is limited, and does not, even when a large quantity of oxygen is present, increase, because a portion of the iodine set free enters again into combination with the caustic potassa set free, forming iodide of potassium and iodate of potassa. (3) The testing for ozone by means of a solution of iodide of potassium and starch (or paper prepared therewith) is of no value whatever, unless care has been taken to exclude direct sunlight.

Precipitation of Cobalt by Sulphuretted Hydrogen, and Purification of Salts of Manganese containing Cobalt.—M. Muck.—The gist of this paper is that boiling-hot solutions of cobalt are, even when free acid is present, readily precipitated by sulphuretted hydrogen. When there is added to such a solution carbonate of manganese, in sufficient quantity, the sulphide of cobalt is completely precipitated, and, after elimination of the free HS, a pure solution of manganese is obtained. The author also states that there occur many ores of manganese which contain large quantities of cobalt ore.

Phenol from Oxybenzoic Acid.—M. Rosenthal.—The author has prepared phenol by distilling oxybenzoic acid with lime; and on investigation, found it to be in all respects identical with the phenols obtained from tar, salicylic acid, and paraoxybenzoic acid.

Ethyloxybenzoic Acid.—M. Rosenthal.—The author says—I tried to prepare, from oxybenzoic acid, an acid of the formula—

$$C_6H_3 \left\{ \begin{array}{l} OH \\ COOH \\ COOH \end{array} \right.$$

by causing carbonic acid and sodium to act upon the compound

$$C_6H_4 \left\{ \begin{array}{l} OH \\ COOC_2H_5. \end{array} \right.$$

Instead of obtaining the desired result, the author obtained the compound—

$$C_6H_4 \left\{ \begin{array}{l} OC_2H_5 \\ COOH \end{array} \right.$$

which is undoubtedly due to the conversion of Na and C_2H_5; this substance is ethyloxybenzoic acid, and was, on comparison, found to be in every respect identical with the compound obtained by heating oxybenzoic acid with KHO and C_2H_5I.

Les Mondes, November 18, 1869.

Refined Resin Oil.—M. Curie.—When resin is submitted to destructive distillation, it yields various oils of different specific gravity, acetic and phenic acids, water, tar, and gases; the crude oil is often applied for the making of printing-ink, as well as waggon grease. The author treats the crude oils, tar inclusive, with lime, and, by fractioned distillation between 140° and 260°, obtains what is known as essence of resin. At 370°, an oil is obtained which, for lubricating purposes, is nearly as good as best olive oil, and is an excellent substitute for turps in oil-paints. This oil is sold at Bordeaux at fifty francs (£2) per 100 kilos.

Treatment of the Sewage of the City of Rheims.—MM. Houzeau, Devédeis, and Holden.—In a lengthy paper, the authors detail the results of a series of experiments made on a sufficiently large scale to form a proper opinion as to the value and permanent applicability. The processes which have been applied are: (1) Treatment with sulphate of iron and lime; (2) treatment with lignite and lime; (3) treatment with small coal (dust, rather) and a small quantity of sulphate of iron and lime. The two first processes yield a manure; the last a fuel. The city of Rheims is situated on and near the banks of the Vesle, and contains, exclusive of the large garrison, a population of about 61,000 inhabitants. According to a report of M. Maridort, Professor of Chemistry at this place, the process, by means of the use of lignite, is a complete success.

Comptes Rendus des Séances de l'Académie des Sciences, November 29, 1869.

This number contains the following memoirs and papers relating to chemistry and allied sciences:—

Construction of an Optical Plane.—M. Foucault.—It appears that M. A. Martin has found, among the papers left by the deceased author, a short note on the proper means to realise the construction of an optical plane—that is to say, a plane surface so perfect that the reflected ray of light in no respect differs from the incident ray.

Improving Wine by Electricity.—M. Scoutetten.—The author states that the accidental striking of lightning on the house of a vineyard proprietor caused the rupture of several large hogsheads containing wine, which found its way into a cavity existing in the cellar of the house. The owner imagined his wine lost and spoiled, but found, to his astonishment, that the wine, instead of having been deteriorated, had become better than it was before. This accidental occurrence having come to the knowledge of General Marey-Monge, caused the author of this paper to be consulted, and a series of experiments were instituted with various kinds of wine, of inferior as well as medium quality, the result being that a galvanic current, applied to the liquid in the casks, both electrodes consisting of platinum plates, eminently improves even very inferior kinds.

Rendering Rivers Wholesome.—M. Gérardin.—According to this author, the fouling of rivers and water-courses is greatly due to the starch manufactories situate along the same, in consequence of the discharge of water containing up to 7 and 8 per cent of albuminous matter, which soon enters into decay, giving rise to the formation of myriads of lower forms of animal life, which withdraw from the water its dissolved oxygen, and hence cause the destruction of higher organised plants and animals.

Researches on Solar Radiation.—MM. Desains and Branly.—This paper, and the following—

Expansion of Gases—M. Moustier—Are not well suited for useful abstraction.

Molecular Action in Atmospheres of Chlorine, Bromine, and Iodine.—M. Valson.—This memoir contains the results of a series of experiments relating to the capillary action of chlorides, bromides, and iodides in aqueous solution and immersed in gas or vapour of the haloids above mentioned. The results are exhibited in tabulated forms.

New Method for the Preparation of Anhydrous Nitric Acid.—MM. Odet and Vignon.—The authors refer first, at some length, to the now well-known, yet difficult and highly delicate, method of obtaining anhydrous nitric acid, discovered by M. H. St. Claire-Deville. The authors obtain this compound by causing chloride of azotyl to act upon perfectly dry nitrate of silver at from 60° to 70°. Chloride of azotyl is prepared by the action of oxychloride of phosphorus upon nitrate of lead, or, better yet, nitrate of silver. The chloride of azotyl is a slightly yellow-coloured liquid, boiling at 5°, and not frozen at – 31°; in contact with water, this substance is decomposed into nitric and hydrochloric acids. The vapour of this fluid is applied for the decomposition of dry nitrate of silver, in a simple apparatus consisting of U-shaped tubes soldered together by means of suitably-bent glass tubes. The chloride of azotyl is prepared simultaneously with the anhydrous nitric acid, which is collected in a tube placed in freezing mixture at – 25°.

Preparation of Hydrate of Chloral.—M. Roussin.—The mode of preparation here described is precisely the same as that already well-known, and lately quoted by us from a German paper. Pure hydrate of chloral is a snow-white crystalline substance, not exhibiting any smell at the ordinary temperature of the air; it volatilises slowly, without absorbing much moisture, unless it be placed in a very damp place; fuses at 56°; boils at 145°; is completely soluble in a small quantity of water, and also soluble in alcohol, ether, chloroform, sulphide of carbon, benzine, and fatty substances. Its aqueous solution ought to be neutral to test paper, and ought not to become turbid by a solution of nitrate of silver. When, to this aqueous solution of hydrate of chloral, a few drops of a solution of caustic potassa are added, there is formed chloroform, easily recognised by its peculiar smell.

So-called Inverted Sugar.—M. Dubrunfaut.—There is appended to this paper a short foot-note, from which it appears that there belong to it two papers not printed yet, by M. Maumené, without which this subject is not complete.

Radiation from the Moon.—M. Marié-Davy.—A third memoir on the much-vexed question about the heat given off by our satellite. This memoir is a purely mathematico-physical essay.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 16, 1869.

The president, Dr. A. W. Hofmann, opened the ordinary meeting, from the *procès verbal* of which we learn the following items:—Among the ordinary members elected, we find the name of Prof. Chandler, of New York. Prof. Baumhauer, of Haarlem, promises to send to the Society a regular account of all that is done on chemical territory in the Netherlands. The president exhibits several samples of partly crystallised tin, received from M. Fritsche, of St. Petersburg; this crystallisation is the effect of a continued exposure for three hours of the metal to a temperature below the freezing point of mercury. When the metal is exposed for any length of time to this low temperature, it falls completely to a greyish coloured powder; when this powder is heated to 100°, it becomes whitish-grey coloured. The president exhibits several photograms representing partially-crystallised organ-pipes, which had been inspected and photographed by the late Prof. Erdmann. We may mention here that this crystallisation of the tin whereof organ-pipes are made is by no means an uncommon phenomenon, and one not solely due to cold alone, but, in a great measure, to the vibration these pipes are subject to. The president exhibits a number of samples of wool, dyed green with the so-called iodine green, by M. T. Peters, of Chemnitz, and hands round to the members circulars issued by that dyer, and printed in German, French, and English, on the best method of applying this dye.

Preparation of Hydrate of Chloral.—MM. Müller and Paul.—The chief part of this operation consists in passing a current of dry and pure chlorine gas into pure and absolute alcohol, until the contents of the flask are, after about 70 hours, converted into a white and crystalline mass; when this operation is properly conducted, a large quantity of hydrate of chloral is obtained. The authors state that they had found by experiment that the hydrate of chloral is readily sublimed, and may be thus obtained as a dry, snow-white, neutral crystalline powder.

Relation of Mercury-Phenyl to the Aromatic Series.—MM. Dreher and Otto.—Mercury-phenyl is formed by the action of $HgNa_2$ upon C_6H_5Br—

$$2(C_6H_5Br) + HgNa_2 = \left\{ \begin{matrix} C_6H_5 \\ C_6H_5 \end{matrix} \right\} Hg + 2NaBr.$$

The addition of a small quantity of acetic ether greatly promotes the reaction. ClH, IH, and BrH decompose—

$$\left. \begin{matrix} C_6H_5 \\ C_6H_5 \end{matrix} \right\} Hg,$$

according to the following equation:—

$$\left. \begin{matrix} C_6H_5 \\ C_6H_5 \end{matrix} \right\} Hg + 2HCl = HgCl_2 + 2C_6H_5.$$

By the action of chlorine, bromine, and iodine, it is not easy to obtain from mercury-phenyl the respective chlorinated, bromated, and iodated compounds; the reactions and decompositions which take place are represented by the following formulæ:—

$$\left. \begin{matrix} C_6H_5 \\ C_6H_5 \end{matrix} \right\} Hg + 2Cl = \left\{ \begin{matrix} C_6H_5 \\ Cl \end{matrix} \right\} Hg + C_6H_5Cl;$$

when chlorine was made to act upon—

$$\left. \begin{matrix} C_6H_5 \\ Cl \end{matrix} \right\} Hg + 2Cl = C_6H_5Cl + HgCl_2.$$

We refrain from further abstraction of this lengthy paper, which is chiefly composed of a mass of formulæ.

Phosgene.—MM. Emmerling and Lengyel.—This paper is divided into three sections:—(1) *Conversion of carboxysulphide into phosgene.*—Chlorine does not act upon carboxysulphide at the ordinary temperature; but when a dry mixture of both gases is made to pass through a red-hot porcelain tube filled with fragments of broken porcelain, a gaseous mixture of CO, $COCl_2$, SCl_2, and unchanged Cl and COS. In order to recognise the phosgene, and estimate its quantity, the gaseous mixture just alluded to was passed through tubes filled with black sulphuret of antimony, this serving the purpose of separating the phosgene from various admixtures. For the purpose of analysis, the gas was collected in tubes, inside of which a small glass globe was placed, filled with a solution of caustic potassa. After the tubes had been filled with the gas, and sealed, this glass globe was broken (its walls being very thin), by shaking the tube in the fluid contents. After a time, the relative proportions of Cl and S were determined, and in other portions of the gas the CO was separately estimated. (2) *Preparation of phosgene from chloroform.*—This fluid is split up by the action of sulphuric acid and bichromate of potassa, yielding phosgene—

$$2CHCl_3 + 3O = 2 + COCl_2 + H_2OCl_2.$$

Forty parts of strong SO_3, five parts of bichromate, and two parts of chloroform yield, when heated on a water-bath, a phosgene free from oxygen. (3) *Fluid phosgene.*—This was obtained by passing the gas through an U-shaped tube placed in ice. The fluid gas is very volatile, and specifically heavier than water, by which liquid it is decomposed, evolving CO_2.

Under the title of "Correspondence," we meet with a first instalment of a report about the meeting at Inspruck, held in September last. Leaving the excellent and thoroughly German and enthusiastic general account of this meeting, we learn that the chemical section was presided over by Prof. Hlasiwetz, of Vienna, and that eighty-six members regularly attended, while the audience was even rather too large for the large chemistry lecture-room of the University wherein this section met. The following subjects were treated:—

Origin (Entstehung) of Iodoform, and the Applicability of the Formation of Iodoform for Analytical Purposes.—M. Lieben.—Iodoform is, according to this author, the most delicate test for alcohol, provided such substances be absent as might happen to exhibit the same reaction. In ether, even when distilled over sodium, alcohol can be detected by iodoform; and there is no doubt, the author says, that alcohol is formed in all ether which contains or can absorb water. Only those substances which contain CH_3 are capable of forming iodoform.

Modifications of Lactic Acid.—Dr. Wislicenus.—According to the author, there exist three modifications of oxypropionic acid. The lactic acid of fermentation, ethyliden lactic acid, differs from the ethylen lactic acid, and is easily obtained from *β* iod-propionic acid. The lactic acid of muscles differs from the two alluded to, but is not a chemical individual, since it is made up of ethylen lactic acid and a peculiar modification of ethyliden lactic acid.

Phenicin.—Prof. Bolley.—The substance known as phenicin, a brown colouring dye, also known as phenyl brown, is made by adding phenol to a mixture of nitric and sulphuric acids, and by pouring this mixture afterwards into a large bulk of water, when the phenicin is obtained as an amorphous powder. The manufacture of this preparation has given rise already frequently to serious explosions. The author found that the commercial article, as well as the pure article (phenicin), contains binitrophenol, a brown amorphous substance, which is neither a nitro nor a sulpho compound, and produced, it appears, by the action of sulphuric acid upon binitrophenol.

Proteine Compounds.—Dr. Schwarzbach.—The author states that the differences found by many experimenters, in the reaction of the potassio-platinum cyanide with the proteine compounds, is due to the fact that, instead of the Gmelin salt, that of Quadrat has been applied.

Preparation of Iodine Substitution-Products.—Prof. Hlasiwetz.—To the substance which is to be iodised, peroxide of mercury is added, and the requisite quantity of iodine is added afterwards. The researches on this subject are not quite complete.

At the meeting of the Russian Chemical Society, held on the 2nd of October (O.S.) last, the following communications were made (communicated by M. von Richter, St. Petersburg):—

Benzimide.—M. Zinin.—The so-called benzimide of Laurent, $C_{22}H_{12}N_2O_2$, which is formed by the action of hydrocyanic acid upon essential oil of bitter almonds, is converted, when heated to from 160° to 180°, into au amide—

$$C_{22}H_{12}O_2N_2+H_2O=C_7H_6O+C_{16}H_{14}O_2N_2,$$

and into a nitrogenous compound, which is the imide of formobenzilic acid.

Bromocamphoric Acid.—M. Wreden.—When dry camphoric acid is heated with bromine to 120°, monobromocamphoric acid anhydride, $C_{10}H_{13}BrO_3$, is obtained. This substance is nearly entirely insoluble in water, alcohol, and ether, at ordinary temperature; it sublimes at about 60°, but is also partly decomposed at that temperature. When this anhydride is boiled with water, a new acid, $C_{10}H_{14}O_4$, is obtained; this acid is readily soluble in water, alcohol, and ether, crystallises from its aqueous solution, sublimes at 110°, and fuses at 201°. The lead and copper salts of this acid are soluble in water; the soda-salt is a very deliquescent substance.

Valerian Aldehyde and Œnanth Aldehyde.—M. Borodin.—When the two substances just named are heated to 240° in sealed tubes, several products of condensation can be directly obtained; the reaction goes on steadily, water is formed, no resinification takes place, and, on opening the tube, no pressure is experienced. The valerian aldehyde yields, when submitted to fractional distillation, two oily fluids, one of which boils at from 195° to 200°, the other at from 180° to 200°. The analysis of these substances proved the first to be the condensation product of two molecules of aldehyde, from which one molecule of water was expelled; the other substance is a polymer of the last-named.

Atomic Weights.—M. Mendelejeff.—This paper contains a new plan of grouping the elements, according to the numerical value of their atomic weights, in the following manner:—Li, 7; Be, 9·4; B, 11; C, 12; N, 14; O, 16; Fe, 19; Na, 23; Mg, 24; Al, 27·4; Si, 28, and so on; but there is a considerable hiatus between Cl, 35, and the next, Ag, 108. The author points out that this grouping of the elements expresses the law according to which the elements can combine with oxygen.

On Xylidine.—M. Tawildarow.—The author prepared xylidine from isoxylol, which was obtained from coal-tar xylol by boiling that substance with dilute nitric acid. The nitroisoxylol thus obtained was reduced by means of tin and hydrochloric acid, and the xylidine purified by means of caustic potassa; the substance thus obtained is a colourless fluid, boiling at 216°; sp. gr. at 18°, 0·985. The oxalate of xylidine crystallises, and is somewhat soluble in water. When xylidine is submitted to distillation, a solid matter is left, which, on being heated to about 240°, yields a substance soluble in alcohol, crystalline, and fusing at 89°; this is a basic substance containing chlorine; its hydrochloric acid compound has the following composition:—$N(C_8H_9Cl)_3.HCl$. 100 parts of xylidine yielded about from two to three parts of this material.

Polytechnisches Journal von Dingler, second number for October, 1869.

This number contains the following original papers relating to chemistry and allied sciences:—

Blast Furnaces constructed for the Continuous Flowing Off of Slag.—M. Lürmann.—This paper contains the description of an improved blast furnace for ironworks. From a foot-note added to the paper, we learn that the Old Park Iron Company, Shropshire, have adopted the improvements invented by this author, and are highly satisfied with the results.

Chemistry of the Blast Furnace.—M. Schinz.

Manufacture of Steel for the Use of Rifle Guns and Heavy Ordnance at the Works of M. Cockerill, at Seraing.—M. Greiner.—The author states that, at Séraing (near Liége, Belgium), the following three points are rigorously attended to as regards the manufacture of steel for the purpose indicated:—Purity of product: homogeneity thereof; and the exercise of proper control to ensure these requisites. It appears that this branch of manufacture is attended to in a thoroughly scientific manner, the use of the spectroscope, and of chemical analysis and assays, being matters of daily application. The test for carbon is executed in the following manner:—Of two samples of the same kind of steel, 0·2 grm. are placed in beaker-glasses of fully 20 c.c. capacity, and treated with nitric acid of 1·2 sp. gr.; the glasses are kept for four hours on a water-bath, and heated to 80°. The solutions assume a brownish yellow colour, which is compared with the colour which two other solutions of the same quantity of steel, containing a known quantity of carbon (0·61 and 0·63 per cent), assume after the four solutions have been all diluted with the same quantity of

pure water. Suppose the solutions of steel containing known quantities of carbon to be respectively diluted to 252 and 260 c.c. and the solutions of the steel under examination to 142 and 144 c.c., the following calculation will give the required result:

$$\frac{142 \times 61}{252} = 34{\cdot}33; \quad \frac{144 \times 63}{260} = 34{\cdot}90;$$

therefore the average = 34·615 = 0·346 per cent.

Boiler Incrustation, from Lillschacht, near Pribram.—Dr. Mrazek.—The author obtained for analysis and investigation a quantity of a very white, compact, micro-crystalline substance, which was stated to be the incrustation found in a steam boiler fed with water pumped from a mine. On being analysed, the stone was found to consist, in 100 parts, of:—Lime, 33·60; sulphuric acid, 47·41; magnesia, 12·26; water, 5·52; impurities, 0·79. This result leads to the formula $2(CaO,SO_3)+(MgO,HO)$, constituting, in fact, a mixture of anhydrite and brucite. The analysis of the water proved it to contain, in 10,000 parts Sulphuric acid, 5·51; lime, 3·40; magnesia, 0·29; with traces only of chloride of sodium and soluble organic matter. The author also obtained a quantity of mud taken from the same boiler; this mud was found to consist, in 100 parts, of—Anhydrite, 14·24; hydrated magnesia, 2·27; lime, 16·49; carbonic acid, 12·96; clay, particles of quartz, oxides of metals, and metallic sulphides, 30·26; particles of wood and water (the former predominating), 23·78. The author states in this paper that if, in the case of boiler explosions, it is possible to obtain some of the incrustation of the exploded boiler, the analysis of that incrustation may lead to the detection of the cause of the explosion; if due to the want of water, and the boiler-plates becoming red-hot, the exact estimation of the water chemically combined with the incrustation is sufficient, since, if the boiler had been red-hot, the whole of the water of combination will have been expelled.

Apparatus for the Safe Keeping and Transport of Petroleum, Benzol, &c.—Dr. Tech.

Application of Iridium for Staining Glass and China.—M. Frick.—It appears that pure oxide of iridium yields, upon glass and china, a black-coloured stain of so intense and deep a tone of shade that the other substances in use for that purpose are, compared with this colour, of a brownish hue. The pure oxide of iridium is obtained, especially as a bye-product, in the purification of American platinum ores, and may be obtained from M. Rösler, at Frankfort-on-the-Maine.

Moniteur Scientifique, November 15, 1869

Artificial Alizarine.—M. Bolley.—There are at present already three artificial products which come into competition with madder and its various preparations, viz.:—(1) It appears that MM. Græbe and Liebermann have stated, at the congress of German *savants* lately held at Inspruck, that they can dispense with the use of acetic acid and bromine, and will be enabled shortly to bring into the trade a superior product, made by a method different from that described in their patent, and that this new product will be manufactured at Manheim by a celebrated firm of aniline colour makers. (2) Artificial purpurine and alizarine, made by MM. Broenner and Gatzkow, according to their patent, by the action of protronitrate of mercury upon anthrachinon; this process is carried on at Frankfort-on-the-Maine. (3) Artificial alizarine (alizapurine, according to M. Alfraise), prepared, by a process as yet kept secret, by MM. Meister and Lucius, at Hoechst, near the same city just named. The author of this paper just named states that he received from M. Rieve, the head chemist to the firm just alluded to, at Hoechst, a quantity of 500 grms. of the paste (artificial alizarine) in question, with the request to assay it and report thereon. This substance exhibits a greenish brown-coloured, rather fluid paste, containing about 6 per cent of dry solid matter; when this dry substance is cautiously submitted to an elevated temperature, a brick-red coloured sublimate is obtained in needle-shaped crystals, a bulky carbonaceous residue is left, and, on igniting this, the ash is found to contain a large proportion of oxide of iron. The sublimate dissolves in caustic soda, exhibiting a very deep blue-violet colour; this solution yields, by the addition of chloride of barium, a bluish violet-coloured precipitate, which resembles, in a high degree, the precipitate obtained under similar conditions from the alizarine of madder. The ammoniacal solution of the sublimate, and the percipitate formed therein by the baryta-salt, also, resemble the reactions obtained from native alizarine from madder under the same conditions. The sublimate referred to yields, on being boiled with a solution of alum, a partial solution in alum, but the dissolved material precipitates on cooling, and the fluid then exhibits only a rose-red colouration; it would accordingly appear that the sublimate consists mainly of alizarine, mixed with very little purpurine. The results of elementary organic analysis of this substance are quoted as follows, three analyses having been made, and the carbon and hydrogen only put down percentically:—C, 69·23; H, 3·38; C, 66·04; H, 3·28; C, 66·46; H, 3·39. The composition of purpurine, according to M. Schutzenberger, $C_{20}H_{12}O_7$, requires percentically—C, 65·93; H, 3·29. Alizarine dried at 100° is, according to Dr. Schunck, percentically—C, 69·13; H, 4·03; and, according to MM. Bolley and Rose—C, 69·54; H, 3·75. The author infers, from these facts, that the sublimate holds a composition intermediate between alizarine and purpurine; that the first portions of the sublimate above referred to contain more, or, rather, approach more to, alizarine, and the latter portions more to purpurine. On comparing the tinctorial properties of this sublimate with those of alizarine obtained from madder, the following was observed:—(1) In the dry state, the artificial alizarine in question is less suitable as a dye than when it is in paste; (2) its tinctorial power, when dry, is at least equal to one-and-a-half times the same weight of raw (green) alizarine from madder, as prepared by M. Kopp's process; (3) the artificial alizarine dyes mordanted cloth rapidly, but soils the white grounds more than green alizarine; (4) the red is very brilliant and pure after cleansing (*avivage*); (5) the violet assumes, after cleansing, a greyish hue, and the puce and black are excellent. All these colours are fast, and in no way inferior to those obtained from madder. According to the author, the experiments instituted by MM. Alfraise and C. Kœchlin, with the view to prove that the preparation alluded to, and produced by MM. Meister and Co., is neither alizarine nor purpurine—are not made with sufficient care, and with a too impure material (the paste only) to deserve the required confidence. As regards the tinctorial power of the paste, also, this appears to have been overrated by M. C. Kœchlin.

Dyeing with so-called Iodine-Green Paste on Wool.—M. Kalle.—This author, wholesale manufacturer of artificial dyes at Biebrich (Nassau, Prussia), states that, having read the communication on the process described by M. Peters in the number of the 1st of November last of this periodical, he feels obliged to point out the following defects in that communication:—(1) When the workman does not happen to use great skill and precaution, the green does not completely dissolve in acidulated water; hence there is a loss of colouring matter. (2) When the colouring matter does not dissolve completely, filtration has to be resorted to, which it is best to avoid. The author next gives the following directions, referring, however, to the use of a pure paste only:—The paste is mixed up with one or two parts of cold water (the quantity of water depends upon the state of concentration of the paste; if the latter happens to be very fluid, or, what amounts to the same, poor in colouring matter, the addition of water is unnecessary), from six to eight parts of alcohol are added, and the mixture well stirred up. *Impregnation tincture.*—The dye-bath ought to contain, for 1 kilo. of green in pasty state (price 50 francs, £2), 1 kilo. of silicate

of soda of 30 per cent strength, and is brought to the boiling point. When this has been reached, the alcoholic solution of the green above alluded to is poured into the bath, and the wool thoroughly worked through it, without more heating, until the desired shade has been obtained; the wool is next drained, wrung out, and washed in cold water, and then only brought into the developing bath composed as described by M. Peters. The author adds that the developing bath becomes gradually saturated with dye-stuff, and then unfit for use for clear shades of colour; when this point is reached, the liquid is filtered, neutralised with ammonia, a fresh quantity of silicate of soda is added, and the liquid so obtained used as a dye-bath.

Preparation of Victoria Yellow (Binitronaphthol).—MM. Darmstädter and Wichelhaus.—One part of naphthaline is mixed with two parts of concentrated sulphuric acid, and heated on a water-bath until the solution is complete; the sulpho-naphthalic acid so obtained is saturated with soda, and the solution is evaporated to dryness. The sulphonaphthalate of soda is next fused with caustic soda, and the mass resulting from this operation is dissolved in water and supersaturated with HCl, whereby naphthol, or hydrate of naphthyle, is separated. This substance is next boiled with a mixture of sulphuric and nitric acids, yielding binitronaphthol, the yellow colouring matter; this substance is chemically different from, but, after all, isomeric with, the so-called Martius yellow, or binitronaphthylic acid. The formula, $C_{20}H_6.N_2O_8.O_2$, answers for both equally well; industrially speaking, both substances approach each other to such a degree that they may be considered identical; both are best used in the state of ammoniacal salt, this being the most readily soluble salt for each. These materials are employed at Paris for the adulteration of gamboge, and very largely used for the colouration of artificial flowers, leather gloves, &c.

Manufacture of Carbonic Acid on the Large Scale.—M. Dietz.—After reviewing several processes in use for this purpose, the author describes, at great length, a process in actual use at Kama, near Tschistopol, Russia. The gist of the description is that the gas given off by a lime-kiln heated with wood is used as a source of carbonic acid for converting carbonate of soda into bicarbonate. During twenty-four hours, 900 cubic metres of carbonic acid gas are consumed, and the combustion of the wood used for heating the kiln is so regulated as to yield a portion of that gas along with that obtained from the limestone; wood, however, in that locality, is almost a waste material, being extremely abundantly found.

Grotto of the Dead.—We notice the title of this paper, which contains a very interesting description of the Baumo des Morts, near Durfort, Departement Du Gard, France. For the study of the earliest age of man's appearance on the globe, this is a valuable contribution.

Journal für Gasbeleuchtung, Nos. 9 and 10, 1869.

These numbers contain the following original papers relating to chemistry and allied sciences:—

What is Good Gas?—Dr. Schilling.—In a lengthy and exhaustive paper, the author reviews this question on all sides, and comes to the following conclusions. A good and suitable gas for artificial illumination ought to possess the following qualities:—(1) The gas ought to possess a normal illuminating power. The exact determination of the value of the normal illuminating power can only be obtained when the gas made from various qualities of coal, and manufactured according to rational principles, is compared, under exactly identical conditions, with the normal standard candle. Any gas which, by a combustion of 5 cubic feet per hour, exhibits a light equal to fifteen spermaceti candles, may be considered a gas of good illuminating power. (2) The gas should be absolutely free from sulphuretted hydrogen. (3) The pressure of the gas at the works and in the leading mains should as a minimum, amount to from 0·8 to 1·0 of the water-pressure gauge.

Researches on the Coals from Saarbrueck.—M. Gasch.—A most valuable addition to the chemistry and technology of coals, containing the results of elementary organic analysis, the quantity and quality of gas and coke yielded by each kind of coal, the transportability of the coal (*i.e.*, the resistance against breakage and falling into smalls and dust), carefully determined. The value of coal and coke as fuel, and the exact determination of the illuminating power and durability of the gas, when manufactured on the large scale, according to the best method, including pyrometrical measurement of heat applied to the retorts.

Gas Meter Testing Regulations for the North German Confederation.

Hydrogen and Carbonic Oxide Gas.—M. Schinz.—The author proposes the use of a mixture of equal quantities, by bulk, of these gases, instead of hydrogen only, for illuminating purposes, by means of incandescent platinum. Experiments made prove that the illuminating power of this mixture is, for equal consumption, equal to 1·242, coal gas of good quality being 1·0.

Photometrical Studies.—Dr. Rüdorff.

Contribution to the Purifying Question.—M. Cox.—Under this title, the author discusses and elucidates, by a series of experiments, the action of sulphuretted hydrogen and hydrated peroxide of iron.

Comparison of Various Kinds of Gas in reference to its Cost of Production and Illuminating Power.—M. Sautter.

Zeitschrift für Chemie von Beilstein, No. 21, 1869.

This number contains the following original papers:—

Formation of Glycolamidic Acids.—M. Ziegler.—When a concentrated solution of glycocol and monochloroacetic acid is boiled with chlorinated diglycolamidic acid, the result is triglycolamidic acid; but since, when glycolic acid and ammonia are boiled with the same substances, neither glycol, nor di- and triglycolamidic acid are formed, the author thinks there is no doubt that, when these acids are prepared from ammonia and monochloro-acetic acid, the one is formed after the other, because an atom of hydrogen bound to one of nitrogen combines with an atom of chlorine of the monochloro-acetic acid.

New Mode of the Formation of a Triphenyl-Guanidine.—MM. Merz and Weith.—Equal molecular quantities of aniline, carbanilide, and one third molecule of trichloride of phosphorus, yield, when mixed, a solid mass, which, while fusing at 140°, effervesces strongly, and, giving off hydrochloric acid, is converted into a basic substance and phosphorous acid (when carbanilide and aniline alone are heated together to about 190°, no reaction takes place). The basic substance just alluded to is, after having been purified, found to be triphenyl-guanidine, fusing at 143°; its platinum compound contains 19·85 to 20·01 per cent metal. This reaction is represented by the following formula:—

$$\left.\begin{array}{l} N<\begin{matrix}C_6H_5\\H\end{matrix} \\ | \\ 3CO \\ | \\ N<\begin{matrix}H\\C_6H_5\end{matrix}\end{array}\right\} + 3C_6H_5.NH_2PCl_3 = \left\{\begin{array}{l} N<\begin{matrix}C_6H_5\\H\end{matrix} \\ | \\ 3C=NC_6H^5+8HCl+H_3PO_3 \\ | \\ N<\begin{matrix}H\\C_6H_5\end{matrix}\end{array}\right.$$

100 parts of carbanilide yield 135·3 parts of this basic substance.

Decomposition of Dichlorobromo-Hydrine by Hydrate of Baryta.—M. Claus.—This paper may be briefly summarised in the following words:—It appears that a dispute has arisen between the author and some other scientific chemists, on the subject of the action of baryta and dichlorobromo-hydrine. Among the products of decomposition,

propyl-phycitic acid was found by some of the parties; the author now says that that acid is only glycerinic acid, and quadriacid-propyl-phycitic alchohol, formerly supposed by the author to exist, has not had its existence proved with sufficient accuracy.

Bulletin de l'Académie Impériale des Sciences de St. Petersbourg, Vol. xiv., No. 2, 1869.

The only paper relating to chemistry in this number is:—

Absorption of Hydrogenium by Iron Galvanically Obtained.—M. Jacobi.—Iron, precipitated galvanically, is described by the author as a silver-grey coloured, velvety-looking, very finely-grained mass, of 7·675 sp.gr. at 15°; this metal is so hard that it scratches glass, but is, also, very brittle. When this metal was very carefully ignited in a covered platinum crucible, its colour became deeper, its hardness and brittleness were lost, and its sp. gr. had increased to 7·811, which is higher than that of wrought-iron. The fact of this increase of specific gravity led the author to conclude that the iron might contain gas absorbed in its substance. A quantity of 9·730 grms. were treated in a Sprengel's aspirator, with the result that, aided by an increased temperature, which was carried to dull-red heat, 17·76 volumes of gas, chiefly composed of hydrogen, were obtained from the quantity of iron submitted to experiment.

Les Mondes, November 25, 1869.

This number contains the following original matter:—

Speech at the Opening Meeting of the German Naturalists and Physicists, at Insprueck.—Dr. Helmholtz.—From this very eloquent and very able speech, we quote the few following phrases:—The discovery of the common tie existing between and uniting together all the phenomena of nature, is the final aim of all science, and towards the reaching of that aim the efforts of all workers of science must be directed; only the knowledge of the laws which rule and govern the material world will enable man to make it obey his will. The speaker, in his discourse, referred briefly to astronomy, as the science of the laws of gravitation; to chemistry, as the science of inalterability of matter and its varied combinations; and next spoke about conservation of forces. At the conclusion, the speaker stated that Germany is, therefore, in advance of all the rest of the scientific world; because, out of that country, and more especially in France and England, scientific men had to heed social, and, far more yet, religious prejudices, and were thereby prevented free utterance of thought, since it would damage their social influence. On the whole, the speech is thoroughly Teutonic in the highest sense of the word, and the terseness, as well as the eloquence of the printed report, cannot fail to imbue the reader with respect for the very sound and able manner wherewith the eminent speaker discussed, extempore, abstruse scientific truths. Under the presidency of Prof. Hlasiwetz, of Vienna, the following papers were read in the chemical section: (1) On "Iodoform," M. Lieben; (2) "On Lactic Acid," M. Wislicenus; (3) "On Phenylic Brown," M. Rolly; (4) "On Proteine Substances," M. Schwartzenbach; (5) "On the Sulphurets of Nitrogen," M. Claus; (6) "On the Hydruret of Palladium," M. Boettger; (7) "On Anthracen," M Petersen; (8) "On Hydrargyrodinaphthyl and Phenyl," M. Otto.

Presence of Salt in Sea Air.—Dr. Gillebert d'Hercourt.—From a series of observations made at Monaco, on the shores of the Mediterranean, the author concludes that there is always on the sea shores an atmosphere impregnated with saline particles; this layer of air has, at the above-named place, some 500 metres' horizontal, and some 60 metres' vertical extent. This impregnation of salt is due to what the author terms "pulverisation" of the sea-water by the breaking-up of the surf, and is not directly influenced either by barometric pressure, hygrometric state of the atmosphere, or its temperature. This hydro-mineral dust (*poussière*), as it is called by the author, is, unless there happen to exist near the coast physical obstacles, in the shape of high mountains, carried far away inland, and is not to be confounded with what is of more coarse nature, and termed "spray," which is only quite local, and produced when a gale of wind blows. The author states that, even on calm days in winter, the atmosphere near Monaco is at least up to a height of 70 metres, and some few miles inland impregnated with this hydro-mineral dust. There is no tide (rise or fall of water) perceptible in the sea alluded to.

Journal de Pharmacie et de Chimie, November, 1869.

This number contains the following original papers:

Researches on the Bleaching of Tissues.—M. Kolb.—The second portion of a lengthy paper on this subject.

On Carlinate of Potassa and Carlinic Acid.—M. Lefranc.—Carlinate of potassa is a white-coloured salt, crystallising in needle-shaped crystals, and soluble in water and in alcohol of 60 per cent. When it is carefully heated, it fuses in its water of crystallisation; and when the heat is increased, it burns off, leaving carbonate of potassa. The aqueous solution of this salt gives no precipitate with chloride of barium, and with neutral or basic acetate of lead; with nitrate of silver it yields a white precipitate, insoluble in acetic, but soluble in nitric acid. The carlinic acid is separated from any concentrated aqueous solution of a carlinate, by means of a slight excess of tartaric acid. Alcohol is added in excess, the fluid filtered, and next evaporated upon a water-bath to dryness, and taken up with ether, from which the acid separates, on evaporation, in a crystalline shape. The acid is very soluble in water, alcohol, and ether, and is naturally met with in the roots of the *Carlina gummifera*, L.

Best Method of Preparation of Emetics.—M. Fleury.—This is a short memoir, not, as would be inferred from its title, on the preparation of the potassio-tartrate of antimony, but on the preparation of a series of double salts of tartaric acid and bismuth with lime, baryta, magnesia, protoxide of manganese, oxides of copper and zinc; of tartaric acid with chromium, lime, and baryta, and similar salts of iron. The author promises to give, in a future paper, the mode of preparation and analysis of all these salts.

On Chloral.—M. Poggiale.—The contents of this paper are superseded by the paper on this subject abstracted by us from the *Berichte der Deutschen Chemischen Gesellschaft zu Berlin*, No. 16, 1869.

Camphor Water.—M. Jeannel.—The question of the solubility of camphor in water has been often discussed. According to the author, an alcoholic solution of camphor was made containing 0·375 grm. per c.c.; and a litre of water at 15° does not dissolve more than 0·75 grm. of camphor from this solution after twenty-four hours' contact and frequent shaking. The author states that alcohol does not increase perceptibly the solubility of camphor in water; alcohol at 20° only dissolves 2·437 grms. of camphor, and at 35°, 6 grms of that substance per litre of alcohol.

Explosion Caused by the Incautious Making-Up of a Medicinal Prescription.—M. Vigla.—The following prescription was handed to a pharmaceutist:—Chlorate of potassa, 8; hypophosphite of soda, 4; simple syrup, 62; water, 125. The operator put the dry salts in a mortar, and commenced rubbing them vigorously, when a most violent explosion ensued, whereby the mortar was smashed to atoms and the operator seriously wounded. The proper course would have been to dissolve each of the salts separately in water.

Moniteur Scientifique, December 1, 1869.

This number contains the following original papers:—

The Physical Phenomena Manifested by Living Organised Beings.—M. Gavarret.—In a lengthy paper

the author discusses and explains the physico-chemical phenomena of life, as far as this is possible. The paper is recommended to the attention of all who study biology.

Artificial Alizarine made by MM. Meister, Lucius, and Co., at Hoechst.—M. Kopp.—Since this subject is, in a scientific as well as industrial point of view, of great importance, we abstract this paper, notwithstanding the same subject has been lately treated by Dr. Bolley. M. Kopp received, from the well-known chemist, M. C. Kœchlin, a quantity of 250 grms. of this artificial alizarine, in the shape of a paste, containing only 7 per cent of dry substance, ash inclusive. The author states that this substance produces a most brilliant and very fast Turkey red. The artificial alizarine was dissolved in a weak aqueous solution of carbonate of soda, filtered and precipitated by means of pure HCl, and the precipitate collected on a filter until the filtrate was quite neutral; the material, thus purified, was used for the purpose of comparison with pure alizarine as obtained from madder. Equal quantities of each of these two substances were dissolved in a weak solution of caustic soda, and with these solutions the following tests were made:—Artificial alizarine $+Na_2O+Cl_2Ba$: violet-blue precipitate, supernatant liquid somewhat faintly rose-coloured; natural alizarine, and the same reagents; also a violet-blue precipitate, supernatant liquid faintly yellowish-rose coloured. Artificial alizarine $+Na_2O+ClCa$: a violet precipitate, supernatant liquid wine-red coloured; natural alizarine, and ditto reagents, ditto precipitate, supernatant liquid wine-red coloured, but less deeply. Other reactions were instituted, all leading to the manifest conclusion that there is no essential difference between this artificial alizarine and natural alizarine. The author records, at length, his experiments with this artificial alizarine, and the action of nitric acid upon this substance, the result of which is that the substance in question gives rise, not only to the formation of phthalic acid, but also nitro-picric acid. When this dried artificial alizarine is treated, at between 150° and 170°, with boiling petroleum oil, a large proportion of the colouring matter is dissolved, and, on cooling, deposited from the oil in needle-shaped crystals. Dr. Quesneville, the editor of the periodical above quoted, adds to M. Kopp's paper a letter received by him, the main purport of which is that MM. Græbe and Liebermann, at Berlin, have been having, with the firm of Meister, Lucius and Co., a lengthy correspondence, and have been treating with them for the carrying out of their invention on the large scale. These negotiations do not appear to have been successful; and the head of the firm at Mannheim, which now carries on the working of the patent of MM. Græbe and Liebermann, at Berlin, have been having, while the negotiations with the firm at Hoechst were still pending, accepted the terms made by MM. Græbe and Liebermann; and there is reason to suppose—and this supposition is strongly confirmed by the researches made by MM. Kœchlin, Bolley, Alfraise, and Kopp, on the artificial alizarine made at Hoechst—that that substance is, in reality, obtained by the process discovered by MM. Græbe and Liebermann, and not, as it is made to appear, by a peculiar process the invention of the manufacturers.

On Ipecacuanha and Emetine.—M. Lefort.

Use of Alkaline Sulphurets for the Purpose of Bleaching Fibres and Tissues of Vegetable Origin.—M. Tessie du Motay.—The chief point in this paper is that the author supposes that the alternate action of reducing and oxidising substances accelerates the bleaching of hemp, flax, and cotton, and the tissues made thereof, and that the strength of the fibre is less impaired by this process. The substances applied as reducing materials are the sulphides of barium or calcium mixed with some sulphide of sodium, and the oxidising substance is chlorine water.

Revue Hebdomadaire de Chimie, November 25, 1869.

New Kind of Gas Furnace.—MM. Bergé and Delheid.—This furnace, or, better, blast-lamp, is a modification of the Bunsen burners in general use, and differs from the latter in the following particulars:—(1) By the mode of the admission of the air, which is made to come in below the gas, and not on the same level therewith, or above it, as in the ordinary Bunsen burners; (2) by the admission of a larger quantity of air, by making it pass through the entire area of the tube; (3) by the addition of an outer cylinder, placed to prevent the heating of the tube from which the flame issues, by making a current of air pass between the two. From the report of the makers of this apparatus, it appears to be of immense service, especially for fusions of mineral substances requiring a high temperature and long-continued heat.

Mode of Treatment of the Fermented Molasses' Juice in order to Extract therefrom Crude Potassa Salts.—MM. Crespel and Bocquet.—The authors add, to the residue of the distillation of the previously-fermented molasses as obtained from beet-root sugar making, a sufficient quantity of carbonate of baryta to convert the sulphuric acid present therein as sulphates into carbonates, and thus to obtain more carbonate of potassa in the saline residue after calcination. The sulphate of baryta formed hereby is re-converted into carbonate by well-known methods.

Formation of Ellagic Acid by means of Gallic Acid.—M. Lowe.—When an aqueous solution of two equivalents of gallic acid and one equivalent of arsenious acid is boiled for several hours, a crystalline precipitate is formed, which is ellagic acid. When it is desired to prepare the latter in quantity, the mixture of the two substances alluded to is made in the proportions mentioned, and, after having been boiled and evaporated to dryness at 120°, is exhausted with alcohol at 90 per cent, wherein the ellagic acid only is soluble.

December 2, 1869.

Salts of Uranium and Cobalt.—M. Selhorst states that, notwithstanding some assertions made to the contrary, the solutions of salts of uranium and cobalt are not fluorescent in Geissler's tubes.

Chemical Method of Purifying Tissues made of Animal Fibres.—MM. Bang and Monestier.—The authors state that woollen and silken tissues are purified from vegetable fibres accidentally mixed up therewith, by steeping the tissues in a mixture of equal parts of water and strong sulphuric acid at 90° temperature, followed immediately by a very efficient washing in plenty of cold water, best a running stream.

Bleaching Wool and Silk.—M. Frézon.—The author proposes to substitute, for the ordinary sulphuring, as it is termed, the use of a mixture of equal parts, by weight, of oxalic acid and common salt, of each 2 kilos, upon 1000 litres of water. The tissues, or yarn, to be bleached is left in this bath for one hour, and next washed in plenty of fresh water.

Boiling-Point of some Concentrated Solutions of Salts.—M. Legrand.—Upon 100 parts of water, each of the following substances, in the quantities quoted, yields a solution, the boiling-point of which is expressed in °C.:—61·5 of chlorate of potassa, 104·2°; 60·1 of chloride of barium, 104·4°; 48·5 of carbonate of soda, 104·63°; 112·6 of phosphate of soda, 106·6°; 59·4 of chloride of potassium, 108·3°; 41·2 of chloride of sodium, 108·4°; 88·9 of chloride of ammonium, 114·2°; 296·2 of neutral tartrate of potassa, 114·67°; 335·1 of nitrate of potassa, 115·9°; 117·5 of chloride of strontium, 117·85°; 224·8 of nitrate of soda, 121·9°; 209·0 of acetate of soda, 124·37°; 205·0 of carbonate of potassa, 135°; 362·2 of nitrate of lime, 151°; 798·2 of acetate of potassa, 169°; 325 of chloride of calcium, 179·5°; an unlimited quantity of nitrate of ammonia, 180°. All the salts to be applied in dry state.

The Journal of the Franklin Institute, October, 1869.

This number contains the following original papers relating to chemistry and allied sciences:—

Various Processes for Preserving Timber.—Dr. Ott.—From this paper, the second portion of a lengthy memoir on this subject, we learn that the opinion that carbolic acid, and substances containing it, or supposed to contain it, are effectual in preserving timber, is erroneous. The real preservative action of the tar-oils are due, according to this author, to a greenish fluorescent oil that comes over at the last stage of the distillation. Direct trials with pyren and paranaphthaline do not yield successful results. The question whether tar (coal-tar) does contain a sufficient quantity of the fluorescent greenish oil just alluded to, so as to justify the use of coal-tar for preservative purposes, is answered in the negative. The decay of timber, or peculiar transformation which makes it unfit for practical purposes, seems to be, in most instances, produced by the attack of fungi and lichens. The mouldering of wood is distinct from decay, it being merely a chemical process caused by the action of water with small access of air. None of the processes invented to preserve timber by chemicals are perfect; the most simple and practical method is the old, but, unfortunately, far too slow, plan of properly subjecting timber to the action of air and water, as practised in ship-building yards.

This number is almost entirely filled with various valuable papers on the late solar eclipse.

American Journal of Pharmacy, November, 1869.

This number contains the following matter more particularly relating to chemistry:—

Prevention of the Bumping of Liquids.—M. Schumann.—After briefly referring to the several suggestions made for this purpose, and, among these, in particular to Dr. H. Müller's process, the author says—In distilling acids and other liquids, I proceed in the following manner:—The end of an ordinary glass pipe, of about ½ of an inch opening, is shut at one end, and this end bent into a little hook; the glass pipe is then cut exactly so long as to reach from the bottom of a glass retort to within ½ or 1 inch of the stopper of the tubulus. By means of the hook and a piece of twine, or a little hook of thin wire, this glass pipe is placed into the retort, the open end at the bottom, and the retort can be filled, or the retort is filled first and the glass pipe entered afterwards. If the liquid is warmed, the air in the glass tube is expanded, and constantly bubbles out at the open end; and if the boiling-point is reached, vapours of the tension of the atmosphere are formed at the spot where the glass pipe stands on the bottom of the retort, and the boiling continues regularly and quietly.

New Properties and Uses of Naphthaline.—Dr. Ott.—After relating the manufacture of this substance, the author says—Pure naphthaline, as now met in the trade, is similar to alabaster, cracks easily in the warm hands, and becomes negatively electric on being rubbed with silk. Its sp. gr. at 66° F. is 1·15173, melts at 174° F., and boils at 452° F. Molten naphthaline absorbs a large quantity of air, which is given off again on cooling; according to M. Vohl, this gas is pure oxygen. Molten naphthaline dissolves indigo with great facility, forming a dark blue violet liquid, from which the indigo separates on cooling, forming fine shining needles like copper. The amorphous sulphides of arsenic, tin, and antimony are also readily dissolved, and likewise phosphorus, sulphur, iodine, the iodide and chloride of mercury, arsenious, succinic, benzoic, and oxalic acids. Naphthaline can be converted into naphthalic, or phthalic acid, and this latter into benzoic acid, and that, in its turn, into benzol. Naphthaline, $C_{20}H_8$; phthalic acid, $C_{16}H_4O_8$; benzoic acid, $C_{14}H_6O_3$; benzol, $C_{12}H_6$. For the conversion of naphthaline into phthalic acid, 12 parts of pure naphthaline are dissolved in 90 parts of concentrated sulphuric acid, and, next, 80 parts of best finely-powdered peroxide of manganese are added. After the reaction is complete, the product is boiled in five times its own bulk of water, until no more carbonic acid gas is given off; the fluid is next diluted with water, filtered, and evaporated. The conversion of the phthalic acid into benzoate of lime, at a temperature of from 625 to 660° F., is performed in vacuum, but requires considerable skill and practice; an excess of lime is required.

Comptes Rendus des Séances de l'Académie des Sciences, December 6, 1869.

This number contains the following original papers relating to chemistry and allied sciences:—

Influence which Water Exercises upon the Double Decomposition of Saline Matter and upon the Thermic Phenomena by which these Decompositions are Accompanied.—M. Marignac.—This paper records the results of a series of experiments made with the view to ascertain, by the measurement of the thermal phenomena, what really takes place in double decomposition when rather dilute saline solutions are operated upon. When water is added to any solution of a salt or acid, a variation of temperature always takes place, which may be an absorption of heat or a disengagement thereof, but which does not exceed 0·2° for solutions of 1-10th, and becomes less for more dilute solutions. This rule is not, however, absolute, because the thermic effect caused by the dilution of sulphuric acid becomes greater with more diluted solutions. The figures 92, 135, 185, 255, express the caloric per equivalent (49), according to the state of the dilution, being 1-10th, 1-20th, 1-40th, 1-80th. The mixing of solutions of two salts which cannot decompose each other gives rise to thermic effects which are less marked. We regret that space forbids us now to enter into more details of this subject.

Reply to Remarks made by M. V. Regnault concerning Thermometers, and the Measurement of Temperature with these Instruments.—M. Bosscha.—The author answers the objections made by M. Regnault, and states that the paper of the latter does not teach anything certain on the indications of the thermometer between 0° and 100°; that M. Regnault considers that differences of 0·2° to 0·3° are insignificant quantities, which are too difficult to estimate, and may be neglected. The greater part of this paper is devoted to the question of the influence of peculiar kinds of glass on thermometers constructed with them.

Remarks on some Matters Relating to Spectrum Analysis.—M. Lecoq de Boisbaudran.—The author, in this paper, gives a preliminary account of the spectrum of the aureola emitted by the positive pole, that of the blue light of the negative pole, and that of the tail of fire (*trait de feu*). It being the author's intention to publish a memoir on this subject, we confine our abstract to this enumeration of contents.

Illumination of Transparent Substances.—M. Soret.—This paper contains, chiefly, observations on the labours made on this subject by M. Lallemand, and there is attached to it a short note by M. Chevreul, who points out, in reference to observations made by the author as to the great difficulty of obtaining perfectly pure water, and the effect of that fluid upon glass vessels, that, as far back as the year 1811, he (M. Chevreul) found ammonia in all waters, however carefully distilled, and, besides this, he found it invariably to contain alkaline silicates, derived from its action upon glass, which is, even at comparatively low temperatures, acted upon by water. The eminent *savant* states that the bottles in use in his laboratory are made of green glass, which does not contain lead, and is better fit to resist the action of water, as well as of chemicals.

Researches on the Action of Contact (Catalytic Force of Berzelius).—M. Dubrunfaut.

Normal Quantity of Sugar Contained in Wine.—M. Petit.—The author states that he has tested several samples of Bordeaux, Burgundy, Cahors wines, and wines produced in the Departments of du Cher, de la Loire, and de l'Indre, and found that the quantity of sugar contained therein varies from 5 to 0·5 grms. to the litre of wine. No

sugar could be detected in old wines. The quantitative estimation of sugar in these fluids is done by the author in the previously decolourised wines (by means of filtration through animal charcoal), and treating the filtered liquid with the well-known Fehling reagent. The sugar may be obtained in the separate state by saturating the wine with lime-water, evaporating to dryness, and treating the residue with alcohol at 40° (95 per cent). The sugar is left, on evaporation of the alcohol, and may be used for controlling the Fehling test by means of fermentation.

Chemical Composition of Fossil-Bones.— M. Scheurer-Kestner.—This very interesting and lengthy paper contains a series of results of analysis obtained by the investigation of fossil-bones of mammoth horses, and of bones of human skeletons belonging to the earlier centuries of our era. The author points out and proves that chemical analysis can decide the question of the respective ages of bones of various animals found mixed up together, and thus prove that these beings have not necessarily been contemporaneous with each other. This paper contains a large number of tabulated results of analysis made with the special view to careful estimation of the organic matter contained in the various bones. As instances, we quote the following, expressed in 100 parts:—Parietal human bone—Ordinary osseine, 3·1; osseine, soluble in dilute HCl, 12·3; water, 6·0; silica, 3·5; bone-earth (phosphate and carbonate of lime), 74·4. Fossil-horse—Ordinary osseine, 3·9; soluble osseine, 9·3; water, 6·8; silica, 0·3; bone-earth, 79·3. Mammoth bones—Ordinary osseine, 2·8; soluble osseine, 8·9; water, 5·7; silica, 12·4; bone-earth, 70·1. These bones were found in the Lehm, near Colmar, Bas-Rhin.

December 13, 1869.

This number contains the following papers relating to chemistry and allied sciences:—

The Siderostat.—M. Leon Foucault.—This paper belongs strictly to astronomy, but the reason why we notice it is that it opens with a brief, but well-deserved observation, bearing testimony to the great value set by His Majesty the Emperor of the French upon science, and the aid given by him, and from his private funds, to promote the labours of scientific men in general, and in this special case to cause, at his expense, the continuation and publishing of the works of the deceased *savant* named at the head of this paragraph.

Constitution of Amygdaline and Phloridzine. M. H. Schiff.—The author states that when he published a paper on arbutine, he briefly alluded to the subject of this paper, and gives, for the two substances just named, the following formulæ:—

$$\underbrace{C_6H_7\left\{\begin{matrix}O\\(OH)_4\end{matrix}\right.}_{\text{Amygdaline.}} \qquad \underbrace{C_6H_7\left\{\begin{matrix}O\\(OH)_4\end{matrix}\right.}_{\text{Phloridzine.}}$$

$$C_6H_7\left\{\begin{matrix}O\\(OH)_3\\O\end{matrix}\right. \qquad C_6H_3\left\{\begin{matrix}O\\OH\\O\end{matrix}\right.$$

$$C_6H_7\left\{\begin{matrix}O\\CN\end{matrix}\right. \qquad C_6H_6[CO.OH$$

When amygdaline is treated with boiling anhydrous acetic acid, there is formed an heptacetylous amygdaline—

$$C_{12}H_{14}O_4\left\{\begin{matrix}(O.C_2H_3O)_7\\C_7H_6.CN\end{matrix}\right.$$

It is a solid substance, crystallising in needle-shaped crystals; amygdaline does not contain benzoyl, (C_7H_5O). When amygdaline is treated with aniline, which only acts upon the former at a temperature of between 160° and 180°, there is formed amygdaline-anilide—

$$C_6H_7\left\{\begin{matrix}N.C_6H_5\\(OH)_4\end{matrix}\right.$$

$$C_6H_7\left\{\begin{matrix}O\\(OH)_3\\O\end{matrix}\right.$$

$$C_6H_7\left\{\begin{matrix}O\\CN\end{matrix}\right.$$

This anilide is not crystallisable, and is very unstable, since, by the addition of boiling water, it is decomposed into aniline and amygdaline. Amygdaline does not contain any ammonia, and is not an amide of amygdalic acid, the formula of which is—

$$C_{12}H_{14}O_4\left\{\begin{matrix}(OH)_7\\C_7H_6.CO_2H.\end{matrix}\right.$$

When anhydrous acetic acid acts upon phloridzine, three acetylated derivatives are obtained; one of these is crystalline, the two others are amorphous; they are represented by the following formulæ:—

$$\underbrace{C_6H_3O\left\{\begin{matrix}(OH)_4\\O\end{matrix}\right.}_{\text{Acetyl-phloridzine.}} \qquad \underbrace{C_6H_7\left\{\begin{matrix}(OH)_2\\(O.C_2H_3O)_2\end{matrix}\right.}_{\text{Triacetyl-phloridzine.}} \qquad \underbrace{C_6H_7[(O.C_2H_3O)_4}_{\text{Pentacetyl-phloridzine.}}$$

$$C_6H_3\left\{\begin{matrix}O.C_2H_3O\\O.C_6H_9O_2\end{matrix}\right. \qquad C_6H_3\left\{\begin{matrix}O\\O.C_2H_3O\\O.C_6H_9O_2\end{matrix}\right. \qquad C_6H_3\left\{\begin{matrix}O\\O.C_2H_3O\\O.C_6H_9O_2\end{matrix}\right.$$

Facts respecting so-called Interverted Sugar.—M. Maumené.—This paper is a review of the labours of M. Dubrunfaut on this subject.

Spectrum Analysis, as Applied to the Detection of Gaseous Substances, either when Single or Mixed.—M. Dubrunfaut.—This paper is not suited for useful abstraction; we may give it in full at a future period.

Analysis of the Morallon Kind of Emerald from the Muso Mines (New Granada).—M. Boussingault.—In the carburated schist of Itoco two kinds of emeralds are met with, designated by the appellation *canutillos*, crystallised emeralds, always of great value, and *morallones*, amorphous and often fissured stones; of the latter kind the author has had a kilo. to experiment with akin to the first-named species; the colour of the latter varies from very deep green to very pale green, but the morallones are hardly transparent at all. Their sp. gr. is 2·64. On being submitted to strong heat, the loss per cent is 1·92. The analysis of this mineral has, at various periods, given rise, the author states, to some controversy. The older chemists considered that the colour was solely due to metallic oxides. But M. Loewy obtained a large proportion of carbonic acid when he ignited this mineral (the canutillo as well as morallon kind) in a current of oxygen; and he therefore concluded that the colour was due to organic matter. But M. Weehler and other German chemists saw that emeralds kept for an hour at the melting point of copper* did not change colour; and they detected the undeniable presence of oxide of chromium in this mineral. According to the author of this paper, the composition, in 100 parts, of the morallon emerald is:—Silica, 67·2; alumina, 19·4; glucina, 12·7; magnesia, 0·4; with traces of oxide of chromium and lime. Formula:—Al_2O_3, $2SiO_3 + GlO_3, 2SiO_3$.

Moniteur Scientifique, No. 312, December 15, 1869.

This number, chiefly filled with a copious index, does not contain any original papers.

Les Mondes, December 9, 1869.

This number contains the following original papers:—

* According to the latest experiments made on this subject by Dr. van Riemsdijk, at the Utrecht Mint, pure copper, kept in a very slow current of pure and dry hydrogen, requires, for fusion, a temperature of 1330° C.

Phosphorescence of the Sea.—M. Duchemin.—This phenomenon, the cause of which has given rise to much speculative discussion, has been thoroughly investigated by the author, who has been occupied with this subject for four years. The results arrived at may be summarised as follows:—The phosphorescence of the sea is solely due to the presence of myriads of very small infusoria (*Noctiluca miliaris*). These animalculæ emit light, produce phosphorescence, whenever they are agitated, either by mechanical means, by heat not exceeding 39°, for a temperature of 41 kills the animals, and after their death neither electricity, nor the action of cold or alcohol, or the addition of an acid to the sea water, again brings about the phosphorescence. These infusoria are not killed by a strong degree of cold, which seems rather to excite the phosphorescence. An addition of 50 per cent of fresh water to the sea water does not affect the infusoria, but if they are placed in entirely fresh water they are killed. The addition to sea water of alcohol and any dilute acid for a moment greatly excites the infusoria, and a brilliant phosphorescence is the consequence; but the experiment is fatal to them. When the infusoria are kept in perfect darkness for more than a fortnight, they still preserve their faculty of phosphorescence. Electric currents do not kill these beings, which, according to the author, cause to those bathing in the sea sometimes a peculiar exanthema.

December 16, 1869.

Generateurs Inexplosibles (Steam-Boilers which cannot Explode).—MM. Belleville and Co.—This number contains the description, accompanied by several cuts, which merit the attention of all who have to work with steam, especially of high pressure.

Cosmos, December 4, 1869.

The number contains:—

Properties of Vapours (Apparatus Benevides).—M. Benevides.—The apparatus, described and illustrated by a cut, is devised by the author with the view to prove the laws of ebullition, the phenomena of latent heat, the influence of temperature upon the tension of vapours, the mode of action of Giffard's injector, the cold produced by the expansion of very high pressure steam when blown off in the atmosphere, the action of steam as a motive power, and the transformation of the heat of combustion into mechanical force.

December 11, 1869.

Biography of Alexander von Humboldt.—Dr. C. Bruhns.—The author states that this work, of which he is the chief editor, will be published in the following manner:—The general scientific biography of the deceased eminent *savant* will be edited by MM. Avé-Lallemant, Dove, Loewenberg, and Foerster. The second section of the work will contain the following sub-divisions, to each of which the deceased contributed largely:—Meteorology and hydrography, Dr. Dove; physiology, Dr. du Bois Reymond; zoology, Dr. Carus; botany and botanical geography, Dr. Grisebach; geology and mineralogy, Dr. Ewald; geography, Dr. Peschel; astronomy and mathematical geography, Dr. Bruhns; natural philosophy and magnetism, Dr. Wiedermann; Humboldt considered as author, Dr. R. Gosche.

December 18, 1869.

Specific Gravity of the Water of the Black Sea.—M. Lapschine.—While the author, as commander of the Russian navy's corvette *Lwitza* (*Lioness*), was engaged in taking soundings of the depth of the sea above named, he found, at latitude N. 44 25' 30", longitude E. of Poulkowa, 7° 7', the deepest place, amounting to 1020 toises (1 toise=6 feet and 6 and 9-10ths inches, English measure), the sp. gr. of the water at the surface of this spot was 0·013, while the water from the deeper portions of the sea varied in sp. gr. from 1·0151 to 1·0140. The figure 0·0130, just quoted, is exactly as in the original, but is, presumably, intended for 1·013.

Petroleum Sources near the Caspian Sea.—M. Meunier.—The existence of petroleum in this region of Asia has been known from a remote antiquity, but only of late has this material become utilised; and new borings, made according to the American system, have revealed the fact that, from a depth of 250 feet below the surface, petroleum is forced up so as to spout from 50 to 65 feet above the surface, and to yield quantities amounting to 19,000,000 lbs. annually, while 200,000 lbs. of solid paraffin are obtained from a kind of asphalte, very abundantly met with in this remote region.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, October, 1869.

This number contains the following original papers relating to chemistry or allied sciences:—

Bronze Powder.—Dr. Wagner.—After referring to the history of the first application of the scraps and waste of what is commonly called tinsel, or Dutch gold (none of it was or is ever made in the Netherlands; this industry is confined almost entirely to Bavaria), the author treats of the mechanical means whereby the metal is brought to leaf and powder. There are three chief alloys in use, which are designated by the name of the colour, the composition of these being, in 100 parts:—For the light shade—copper, 83; zinc, 17; for the deeper shade—copper, from 90 to 94; zinc, from 10 to 6; for deep copper-red, no zinc at all. Copper may be obtained in finely-divided state by the following chemical means:—By igniting a mixture of chloride of copper, carbonate of soda, and sal ammoniac; by precipitating a solution of acetate of copper by means of sulphurous acid; by decomposing suboxide of copper by means of sulphuric acid; by electrolysis of a solution of sulphate of copper; by precipitating a solution of the last-named salt by means of a bar of iron wrapped up in filtering paper or coarse cotton tissue; but all the metal thus obtained is hard and crystalline, and unsuitable for the purposes it is intended for as bronze powder. The author found that, when oxide of copper, such as is used for elementary organic analysis, is submitted, hot, to the action of the vapours of ligroine (a light petroleum oil, or spirit), it is obtained in an excellent condition, and 100 kilos. of oxide require, for reduction at red heat, only 8 kilos. of ligroine.

Manufacture of Alcohol from Indian Corn.—M. Bergsträsser.—This paper is of interest only to distillers in countries where Indian corn is grown; the material is very suitable for the purpose, and the refuse remaining after distillation is a valuable food for milch cows, on account of the large quantity of fatty matter it contains.

Monatsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin, July and August, 1869.

The papers on chemical subjects in these two numbers have been forestalled by having been published in other German periodicals, from which we abstracted them.

Bibliothèque Universelle et Revue Suisse.—Archives des Sciences Physiques et Naturelles. No. 143, 1869.

This number does not contain any original papers relating to chemistry or allied sciences.

Neues Jahrbuch für Pharmacie, von Dr. F. Vorwerk, October, 1869.

This number contains the following original papers:—

The Doctrines of Modern Chemistry.—Dr. Koller.—This paper contains a very clear review of the doctrines of modern chemistry, as compared with that of some years ago. The contents of this paper are divided into sections with the following headings:—Atomic and molecular weight; type and radical theory; substitution; anhydrides of acids; anhydrides of bases; salts, normal, basic, and acid. The paper is not well suited for useful abstraction.

On Gelatine Medicate.—Dr. Husemann.—This paper relates entirely to the pharmaceutical preparation of medicated gelatine lozenges.

Lithoreactive.—M. Weiss.—The author states that a mixture containing 5 per cent of sugar molasses, or beet-root syrup, 15 per cent of milk of lime (one part of slaked lime to three parts of water), and 80 per cent of caustic soda lye at 34° Beaumé, sp. gr. 1·039, is the best and surest means of preventing, as well as of breaking-up and dissolving, steam-boiler incrustations, while, moreover, this mixture is perfectly innocuous as regards its action upon either copper or iron. The hardest water only requires 1 kilo. of lithoreactive upon 1800 litres of water.

Antimonide.—M. Lichtenberger.—Under this curious name, there is in use a mixture for absorbing the protoxide of iron, while that metal is to be welded in red-hot state. The mixture consists of 4 parts of iron filings or turnings, 3 parts of borax, 2 parts of borate of peroxide of iron, and 1 part of water. The powder is made in the following manner:—To a solution of 3½ parts of borax in water, as much chloride of iron is added as is sufficient to obtain a precipitate of insoluble borate of peroxide of iron; this precipitate is washed upon a filter to remove common salt. This having been done, there is added to the precipitate (previously, of course, put in a suitable vessel) a solution of 3 parts of borax, and this mixture evaporated nearly to dryness, when there is added to it 4 parts of clean iron filings or turnings. The whole is then strongly dried and heated to incipient red-heat, whereby a fusion takes place; and, after cooling, the mass is pulverised.

Comptes Rendus des Séances de l'Académie des Sciences, December 20, 1869.

This number contains the following papers and memoirs relating to chemistry or sciences allied thereto:—

Distribution of Potassa and Soda in Plants.—M. Peligot.—This is a third paper on this subject, and the author treats in it the question whether plants have the faculty of absorbing the alkaline substances contained in the soil, and also whether they can, by any choice, assimilate the salts of potassa in preference to those of soda. The main points of this paper are:—(1) That soda is met with in plants in several distinct forms; this alkali is taken up by the radicles, penetrates into the tissues of the plants, and is found among the mineral matter left after incineration of the same. (2) In some marine plants, soda exists, in the form of salt water, in the sap which fills the tissues of these succulent vegetables. (3) All plants grown sufficiently near the sea-board contain chloride of sodium dispersed over their surface; but the presence of this salt in the ash of such plants does not imply that this salt has contributed to the development of the plants. The discussion of this paper gives rise to a statement of facts observed last autumn by M. Elie de Beaumont, who says that, while staying at Canon, Department du Calvados, and at a distance of 23 kilometres (about 14·3 English miles) from the coast, he observed that, during a severe W. S. W. gale, the leaves of the trees of that part of the country were, so to say, burnt up; and he ascribes this to the pulverised sea-water dust carried inland by this gale, proving that at a great distance from the coast sea-salt may be mechanically brought over.

Observations on the Communication of M. Soret, bearing upon the Illumination of Transparent Substances.—M. Lallemand.

Formation and Duration of Induced Currents.—M. Blaserna.—Both physico-mathematical papers.

Electro-Motor Force Developed by Platinum when it is brought into Contact with Various Liquids.—M. Gangain.—The contents of this paper may be resumed as follows:—(1) That unplatinised platinum which is left for some time in an acid liquid is gradually modified, and thus becomes, after a shorter or longer lapse of time, more positive than it was at the moment of its first immersion. (2) That platinised or unplatinised platinum which is placed in an alkaline fluid becomes gradually more negative.

Researches on the Preparation and Purification of Sulphide of Carbon.—M. Sidot.—The chief results of the experiments made on this subject by the author prove that a full red heat is the best temperature for obtaining the largest quantity of sulphide of carbon from a given weight of sulphur in the state of vapour and charcoal. At a low red heat (*rouge sombre*), as well as at a bright red heat (*rouge vif*), the formation of this sulphide takes place, but the quantity obtained is by far smaller. As regards the purification, the author first re-distils the raw product, then shakes the distillate up with mercury, until the latter becomes black, and this operation is so long repeated as the metal is affected by the fluid, or, rather, by any sulphur dissolved in it. Sulphide of carbon thus purified is freed from the fœtid odour it generally has, and exhibits a smell of ether.

Composition of the Skin, the Modifications it undergoes by Tanning, and the Fermentation of Tannin in the Tan-Pits.—M. Müntz.—The author has investigated the skins and hides during the three principal stages of the operation of tanning it. In fresh state, skin contains from two-thirds to three-fourths of its weight of water; dried at 110°, it becomes one of the most hygroscopical substances we are acquainted with. The immediate analysis of skin led to the following results for 100 parts:—Cellular tissue not acted upon by boiling water, 3·080; fatty matter, 1·058; mineral matter, 0·367; substances capable of forming gelatine, 95·395. During the tanning, the substance fixed in and upon the skin is not tannin, but a derivative thereof, which may be denominated tanning material (*matière tannante*), which differs from tannin in this respect—that it contains less oxygen and more hydrogen. The fermentation going on in the tan-pits takes place with exclusion of air, and gives rise to the formation of lactic, acetic, gallic, formic, and carbonic acids, while a small quantity of propionic acid is also formed.

An Error Committed in Saccharimetrical Estimations.—M. Maumené.—We intend to give a full translation of this paper at a future period.

Annalen der Chemie und Pharmacie, November, 1869.

This number contains the following original papers and memoirs:—

Balsam of Peru.—M. Kraut.—Among the substances originally only known and used in pharmacy, very few have given rise to such a number and such protracted investigations as the balsam just alluded to. The author of this paper has tried to reconcile, and bring into proper harmony, the researches of all his predecessors, and states that the oil of balsam of Peru (the cinnameine of Frémy) has been prepared by him by acting upon the original balsam with a mixture of ether and soda-lye containing about 4 per cent of soda. The ethereal solution is first washed, next deprived of the ether by distillation, and then the oil dried at 120° in a current of pure and dry hydrogen. By fractional distillation, this oil may be separated into three different portions:—(*a*) boils at 200°, and yields, on analysis, C_7H_6O; is converted into benzoic acid, without any evolution of carbonic acid, by the action of chromic acid. (*b*) boils at 300°, contains 79·09 per cent C and 6·0 per cent H, and was found to be benzoate of benzyl ether, a colourless fluid of the consistency of sweet oil of almonds; sp. gr. at 18·5°, 1·114; formula, $C_7H_7.O.C_7H_5O$. (*c*) boils at the boiling-point of mercury; sp. gr. at 23°, 1·050; this substance is cinnamate of benzyl ether—formula, $C_9H_7.O.C_9H_7O$; the dark coloured residue remaining in the retort is styracine. When the oil, as originally

obtained, is submitted to the action of caustic potassa dissolved in alcohol, and the resulting substances examined, the author found:—(*a*) Cinnamate of ethyl ether, $C_9H_8.O.C_2H_5O$; (*b*) benzyl alcohol, boiling at 206·2; sp. gr. at 19°, 1·0465; not solidified at −18°; formula, $C_7H_8.O.H$. The chief constituents of balsam of Peru are—Free cinnamic acid, resin, and the benzyl ethers of benzoic and cinnamic acid.

Action of Sulphurous Acid upon Chloride of Platinum.—M. Birnbaum.—When platino-chloride of ammonium is mixed with an aqueous and concentrated solution of sulphurous acid, care being taken to keep the latter in excess, a yellow solution is obtained which, on being concentrated by evaporation on a water-bath just to the point of crystallisation, and then further dried over sulphuric acid, after addition of some sulphurous acid solution, yields a salt—

$$Pt\left\{\begin{matrix}Cl\\HSO_3\end{matrix}\right\}+2NH_4Cl.$$

This compound is to be considered as a monobasic acid, a view fully confirmed by the fact that, instead of the two molecules of chloride of ammonium, chloride of potassium, or sulphate of ammonium can be taken up. The potassium salt is—

$$Pt\left\{\begin{matrix}Cl\\KSO_3\end{matrix}\right\}+2NH_4Cl.$$

When ammonio-chloride of platinum is treated with acid sulphite of ammonium, a salt is obtained—

$$Pt\left\{\begin{matrix}HSO_3\\HSO_3\end{matrix}\right\}+2NH_4Cl+H_2O.$$

Octyl Compounds.—M. Schorlemmer.

Derivatives of Propan.—M. Schorlemmer.

Action of Bromine upon Ether.—MM. Ladenburg and Wichelhaus.—The action of bromine upon compounds of organic origin is either a substitution or an addition, so that the halogen is found instead of H, or has become incorporated with the organic molecule which is thereby saturated; but this action is not that commonly met with when bromine acts on the substances known as "ethers," since very frequently the halogen in these instances combines with the radical (*e.g.*, C_2H_5), and, while displacing O, causes an intrinsic change of the molecule. The authors have investigated this action more especially with Kay's ether (orthoformic ether), boiling between 146° and 148°; bromine acts upon this fluid, even at the ordinary temperature, forming bromide of ethyl and carbonic ether. The reaction of the halogen upon this orthoformic ether is represented by the following formula:—

$$2CH(OC_2H_5)_3+Br_2=$$
$$=2BrC_2H_5+CO(OC_2H_5)_2+CHO(OC_2H_5)+C_2H_6O.$$

The authors also investigated the action of bromine upon ortho-carbonic, ethyl-glycolic, and ethyl-lactic ether.

Contribution to Our Knowledge of Selenium.—M. Rathke.—This monograph is divided into the following sections:—The allotropic modifications of selenium, and their relation to those of sulphur; sulpho selenium: seleno carbon; selenium-xanthogenic acid; experiments made for the purpose of forming selenium-tetrethyl and sulpho-tetrethyl; ethyl-selenious acid.

Preparation of Zinc Ethyl.—M. Rathke.—The preparation of zinc ethyl, according to the method suggested by MM. Beilstein and Alexeyeff, is rendered of far easier execution when there is added to the mixture of iodide of ethyl and zinc (with or without the addition of sodium amalgam) a small proportion of zinc ethyl from a former operation. The author states that the formation of zinc ethyl is thereby accelerated to such an extent as to admit of the entire operation being finished, by the aid of the heat of a water-bath, in half an hour. When 2 grms. of zinc ethyl are added to 100 grms. of iodide of ethyl, the action becomes sometimes so violent as to necessitate the withdrawal of the source of heat and cooling of the retort wherein that action takes place.

Di- and Tri-Chlorobenzoic Acid.—MM. Beilstein and Kuhlberg.—Tenth portion of a memoir on the subject of "Isomerism of the Benzoic Group." This portion of the monograph is divided into the following chapters:—Dichlorobenzoic acid from dichlorotoluol; dichlorobenzoic acid from benzoic acid; trichlorobenzoic acid from trichlorotoluol; alcohol of trichlorobenzoic acid, $C_6H_2Cl_3.CH_2HO$; trichlorobenzoic acid from benzoic acid.

Action of $SbCl_5$ upon Chloride of Toluol.—MM. Beilstein and Kuhlberg.—The authors, referring to a treatise they published in vol. CL. of this periodical (title not given), now state that when chlorine is passed into boiling tetrachlorotoluol chloride, $C_6HCl_4.CH_2Cl$ (boiling-point, 296°), they obtained, by the fractional distillation of the products of this reaction, a fluid boiling at about 285°, from which, at 84°, crystals were deposited, which proved to be pentachlorobenzol, $C_6H_2Cl_5$. When trichlorotoluol is acted upon by chlorine at its boiling-point, the authors obtained therefrom a substance (tetrachlorobenzol) boiling at 240°, fusing at 140°; formula, $C_6H_3Cl_4$.

Toluchinones.—M. Borgmann.—Trichlorotoluchinon, $C_7H_3Cl_3O_2$, a solid substance exhibiting yellow-coloured crystals; difficultly soluble in cold, but more readily in boiling, alcohol; very readily soluble in ether and chloroform; and readily decomposed by heat. Trichlorotoluhydrochinon, $C_7H_5Cl_3O_2$.—Needle-shaped crystals, readily soluble in alcohol, and fusing at 212°. Bacetyltrichlorotoluhydrochinon—

$$C_6Cl_3\left\{\begin{matrix}CH_3\\O.C_2H_3O\\O.C_2H_3O\end{matrix}\right.$$

a crystalline solid, readily soluble in alcohol and ether, and fusing at 114°. Diethyltrichlorotoluhydrochinon—

$$C_6Cl_3\left\{\begin{matrix}CH_3\\O.C_2H_5\\O.C_2H_5\end{matrix}\right.$$

also a solid substance, fusing at 107°. Monochlorotoluhydrochinonbisulpho acid—

$$C_6Cl\left\{\begin{matrix}CH_3\\OH\\OH\\(SO_3H)_2\end{matrix}\right.$$

a salt soluble in hot water, insoluble in alcohol, and crystallising in leafy-shaped crystals.

Supplementband, vol. vii. No. 1.

This number contains the following original papers and memoirs:—

On Mellitic Acid.—M. Baeyer.—From this very lengthy essay, we quote that mellitic acid was discovered by M. Klaproth, in a mineral called honeystone. The author refers, at some length, to the researches made by MM. Wöhler, Liebig, Erdmann, Gerhardt, and others on this subject, and then states that, according to his own investigation, the most simple formula for mellitic acid is $C_{12}O_{12}H_6$; that is to say, that this acid is a benzol all the H of which has been replaced by the carboxyl group, CO.OH. This is fully proved by the fact that, when mellitic acid is decomposed in contact with soda-lime or lime at a high temperature, benzol and carbonic acid (carbonate of lime) are formed. This treatise is divided into the following sections:—Mellitic acid, which the author says is a sexbasic acid and a rare substance, since the mineral from which it is obtained is very sparingly found. Hydromellitic acid, $C_{12}O_{12}H_{12}$, also a sexbasic acid, obtained from mellitic acid by the action of sodium amalgam. Action of sulphuric acid upon hydromellitic acid, assisted by heat; the products of this action are carbonic acid, a quadribasic,

and a tribasic aromatic acid—viz., isopyromellitic acid, $C_6H_2(CO_2H)_4$; and trimesinic acid, $C_6H_3(CO_2H)_3$. Hydroisopyromellitic acid, $C_{10}O_8H_{16}$. Hemimellitic acid, $C_9O_6H_6$. Pyromellitic acid. $C_{10}H_2O_8$. Hydropyromellitic acid, $C_{10}H_{10}O_8$. Action of sulphuric acid and heat upon hydropyromellitic acid. Trimellitic acid, $C_9H_6O_6$. Isohydromellitic acid, $C_{12}H_{12}O_{12}$. Action of sulphuric acid and heat upon isohydromellitic acid. Action of bromine upon hydromellitic acid. Benzolcarbon acids. Hydrobenzol-carbon acids. It should be mentioned that this paper is only the first part of the author's essay on this subject.

Indol.—M. Baeyer.—Indol can be obtained from indigo by two different methods—viz., by causing the vapours of oxindol to pass over heated powdered zinc; or, also, by heating, with the same metal, the yellow material obtained when indigo-blue is treated with tin and hydrochloric acid. From the author's statement, it appears, however, that indol is a substance which is difficultly prepared and very difficult to obtain in pure state. When pure, indol is a solid substance, soluble in water, crystallisable, fusing at 52°, and readily soluble in alcohol, ether, and hydrocarbons; it is a weak base, not forming salts very readily. Composition, in 100 parts:—C, 82·05; H, 5·98; N, 11·97. Formula, C_8H_7N. Indol is characterised by the peculiarity of producing red-coloured combinations. When the alcoholic solution of indol is mixed with hydrochloric acid, it tinges a piece of fir-wood placed therein cherry-red in a few minutes. The author states that M. Kühne has found indol in the products of decomposition of the pancreatic juice.

New Method of Formation of Monobromacetic Acid.—Dr. Gloeckner.—The author describes, in this essay, a series of experiments made with bromethylen-bromide, $C_2H_3Br_3$, and obtained, especially by treating this substance in sealed tubes exposed to a higher temperature, and containing various substances (as, for instance, BaO, KaO, and water) along with the bromethylen-bromide, among other products, monobromacetic acid.

Action of the Haloids upon the Metallic Derivatives of some Carbon Compounds.—M. Bunge.—The author prepared silver succinimide by boiling pure succinimide with water and oxide of silver. The silver succinimide thus obtained was treated with iodine, and, by means of many carefully executed operations, crystals of pure iodide of succinimide were obtained. This compound is very prone to decomposition, especially when heated, since it cannot bear 100° without very perceptible alteration; it is readily soluble in acetone and water, but difficultly in alcohol and ether. The author obtained, with difficulty, some other compounds, but not in state of sufficient purity for analysis, and failed to substitute cyanogen for the atom of nitrogen which is combined with H in succinimide. Some experiments were also made relating to the action of vapours of bromine upon dried benzoate, oxalate, and succinate of silver; the products hereby obtained are bromobenzoic acid, bromide of silver, and succinic acid.

Zeitschrift für Chemie von Beilstein, No. 22, 1869.

The number contains the following original papers:—

On Cytisin.—Dr. A. Husemann.—This paper contains the account of some additional experiments on this subject, which was briefly abstracted by us from another paper (see Chemical News, vol. xx., p. 36; *Am. Repr., Sept.*, '69, *page* 178). The formula of cytisin is $C_{20}H_{27}N_3O$; it fuses at 154·5°, and can be sublimed when the heat is properly regulated. The nitrate of this base, $C_{20}H_{27}N_3O, (HNO_3)_2 + 2H_2O$, is the only salt which crystallises well; it is soluble in water and dilute alcohol; its taste is far more bitter than that of the base itself. The hydrochlorate of cytisin, $C_{20}H_{27}N_3O.4HCl + 3H_2O$, is a salt very soluble in water. With the following acids, cytisin yields deliquescent salts:—Sulphuric, phosphoric, formic, acetic, propionic, butyric, valerianic, oxalic, and tartaric. With the chlorides of platinum, gold, and mercury (bichloride), cytisin yields double salts, which can be obtained in crystalline state. Among the large number of reactions discovered by the author for the easy detection of this base, the most sensitive are:—A solution of iodine in iodide of potassium produces, even in the most dilute solutions of cytisin, a deep red-brown precipitate, which is at first amorphous, but becomes, when left standing, converted into beautiful transparent deep-red prisms. Bromine water produces, even in solutions containing only 1-15000th part of the base, a distinct cloudiness, and in more concentrated solutions, an orange-coloured precipitate. Chlorine water does not yield any precipitate or cloudiness at all. Cytisin is found in all parts of the well-known tree, *Cytisus laburnum, L.*, except in the wood; the ripe seeds contain a large quantity of this very dangerous substance, which is a poison, whether it be ingested into the alimentary apparatus or subcutaneously applied. From 3 to 5 decigrms. of cytisin, subcutaneously applied, will kill a large dog within half an hour.

On Isomeric Chlorotoluidines.—M. Wroblevsky.—When pure chlorotoluol is gradually treated with nitric acid (sp. gr., 1·475), the author succeeded in obtaining, after having twenty-six times repeated a fractional distillation, two nitro products, one of which boils at 243°, and the other at 253°; the sp. gr. of the former was found to be 1·307, and of the latter 1·325, both at 18°. The product boiling at 243° is designated by *α*, the product boiling at 253° by *β*; the formulæ are—*α*, $C_7H_6Cl(NO_2)$; *β*, $C_7H_6Cl(NO_2)$. Both bodies having been treated with fuming sulphuric acid, yield a sulpho acid; the baryta salt of that acid of the *α* kind is a readily crystallisable salt, rather difficultly soluble in water—formula, $(C_7H_5ClNO_2SO_3)2Ba + 4H_2O$; the baryta salt of the *β* kind is so readily soluble in water that it is impossible to obtain it in pure state. *α* chlorotoluidine, obtained from *α* $C_7H_6Cl(NO_2)$, by the action of Sn and HCl, is a fluid, sp. gr. at 20°, 1·185, boils at 238°, is not solidified at — 14°, insoluble in water, and readily soluble in alcohol; *β* chlorotoluidine is a solid (when pure) crystallising in large foliated crystals, fuses at 38°, boils at 241°, almost insoluble in water, and readily soluble in alcohol. Both these substances yield crystallisable salts.

Contribution to the Knowledge of Sulpho-Nitrogen Acids (Schwefelstickstoffsaeuren).—MM. Claus and Koch.—When neutral aqueous solutions of nitrite of potassa and sulphate of potassa are mixed together, there will be at first formed a cloudiness, or turbidity, shortly followed by the appearance of a quantity of needle-shaped crystals, while the solution becomes, simultaneously, distinctly alkaline to test paper. If concentrated solutions of the salts referred to are mixed, the reaction is finished in a couple of minutes, and the mass has become a thick magma, while, at the same time, the temperature of the mixture sometimes rises to 80°. The authors have investigated this salt, and studied many of its derivatives; the salt alluded to, tetrasulphammonate of potassa (*tetrasulfammonsaureskali*).

$$K_4HNS_4O_{12} + 3H_2O = 4\left(S\begin{matrix}OK\\O_2\end{matrix}\right)_1\Big\}.NH.,$$

is formed according to the following equation:—

$$4(K_2SO_3) + KNO_2 + 3(H_2O) = 5(KHO) + K_4HNS_4O_{12}.$$

The authors describe, at length, the mode of preparation and analysis of trisulphammoniate of potassa—

$$3\left(S\begin{matrix}OK\\O_2\end{matrix}\right).NH_2,$$

obtained from the foregoing salt by the action of water upon it according to the formula—

$$4\left(S\begin{matrix}OK\\O_2\end{matrix}\right).NH + H_2O = 3\left(S\begin{matrix}OK\\O_2\end{matrix}\right).NH_2 + KHSO_4,$$

of a disulphammoniate of potassa—

$$3\left(S\begin{matrix}OK\\O_2\end{matrix}\right).NH_2 + H_2O = 2\left(S\begin{matrix}OK\\O_2\end{matrix}\right).NH_3 + KHSO_4.$$

The preparation and mode of analysis of these salts require very delicate manipulation.

Chemical Constitution of Pyroxiline (Gun Cotton).—Dr. Gintl.—The author states that when gun cotton, and also the collodion wool, are thoroughly moistened with concentrated sulphuric acid, after having been previously washed with water, so as to remove any matters present therein soluble in water, and left quietly standing in a well-closed suitable vessel, the substances will be dissolved and converted into a colourless, syrupy fluid. When this fluid is cautiously diluted with water, so as to prevent any increase of temperature, and next saturated with carbonate of baryta, and the excess of the latter salt, along with the sulphate of that base, are removed by filtration, there is obtained a perfectly colourless fluid, which, after having been evaporated *in vacuo* over sulphuric acid, leaves a gum-like mass, containing crystals of nitrate of baryta. The gum-like matter consists chiefly of the baryta salt of ligno-sulphuric acid (*holzschwefelsäure*), which may be obtained in free state by very cautious and careful removal of the baryta, by means of dilute sulphuric acid. Liguo-sulphuric acid was first discovered by Braconnot.

Revue Hebdomadaire de Chimie, December 9, 1869.

Quantitative Estimation of Sulphur in Cast-Iron and Steel.—M. Eggertz.—The process invented by this author is based upon the shade of colouration which small quantities of sulphuretted hydrogen produce upon pure silver, or certain alloys thereof. In a glass stoppered bottle, of 25 centimetres diameter and 15 decimetres height, a mixture is poured of 1 grm. of water and ½ a grm. of concentrated sulphuric acid. to which is added 1 decigrm. of the metal reduced to the finest possible powder. There suspend, by means of a very fine platinum wire, in the bottle, without touching the fluid, a clean piece of metallic silver, the platinum wire being held squeezed between the stopper and the neck of the bottle. The metal dissolves in a moderately warm room within a quarter of an hour, so that the silver can be taken out and examined after that time. The author has, by means of a series of experiments, been enabled to construct a series of numbers. representing, according to certain shades of colouration, the quantities of sulphur found.

Drop Apparatus for Fluids.—MM. Alvergnat, Frères—This contrivance consists essentially of a flat-bottomed glass flask, round the top portion of which a caoutchouc balloon has been so arranged, that a glass tube bent downwards outside of the flask, and reaching straight down to the bottom, passes air-tight through the balloon. When the latter is compressed, the air it contains forces the liquid in the flask upwards; and this may be so managed as to cause it to flow drop by drop out of the bent tube.

Among the papers, the titles of which we notice, but do not abstract, because they are too lengthy, and do not, moreover, belong to chemical science, are the following:—

Process for the Reproduction of Pictures by Lithography and other means.—M. Mielle.

Furnace Constructed to Burn Spent Tan for the Purpose of Heating Steam-Boilers.—MM. Durand. Frères, 17, Rue de Gobelius, Paris.

NOTES AND QUERIES.

Reducing the Metal from Impure Chloride of Zinc.—Can any of your readers inform me of a practical and profitable method of reducing the metal from impure chloride of zinc?—An Old Subscriber.

Aluminium Sulphide and Phosphide.—(Reply to "D. H")—See Berzelius's "Traité de Chimie," vol. ii, p. 157 (Paris, 1846), and "Handbook of Chemistry," by Gmelin, vol. iii., pp. 309 and 311. Both works may be inspected at the Library of the Commissioners of Patents.

Atomicity of Aluminium.—(Reply to "Dubitans.")—Aluminium is tetratomic and pseudo-triatomic, like carbon. In the simplest formulæ of aluminium compounds, the metal is represented as triatomic, as, for example, $Al'''Cl_3Al'''K'_2SO_4 + 12H_2O$; but the specific gravity of the vapour of aluminium chloride shows that the true formula is Al_2Cl_6, and not $AlCl^3$. Hence it is probable that each aluminium atom is really tetratomic, the constitution of the chloride being—

$$\begin{array}{l} \overset{iv}{Al} \equiv Cl^3 \\ \;| \\ \overset{iv}{Al} \equiv Cl^3 \end{array}$$

—Atomicity.

Gas and Oil Furnaces.—No one seems inclined to give me the information as to getting up white heats in a small furnace with ordinary gas from the mains, from which I infer no one of the readers of the Chemical News has done it, nor sees his way how to do it. As I find, on inquiry at the gas office here (Runcorn), that they will not allow any reduction in price for use in such quantity, save some 2½ discount, I must try oil of some sort or other. Which is best for my purpose? I want to have as *clean* a heat as possible—that is, free from sulphur and deposit of any kind that would interfere with the action of the vapours I introduced on the clay goods in the kiln. At first thought, you would fancy a flame from oil should not leave any deposit; but I am not so sure, as the gas from a gas producer of Siemens's covered the goods with brown-red dust.—J. C.

Glue and Gelatine.—I would feel obliged if any one would refer me to the memoirs which have been published on glue and gelatine, or to any special source of information on these subjects.—G. G.

Utilisation of Sulphate of Lime.—Will any of your readers, through your columns, kindly inorm me of some process, for some book which treats of such process, by which the sulphate of lime obtained in neutralising the superfluous acid when making Glauber's salt, can be turned into manure or any other salable article.—Glauber.

Gas and Oil Furnaces.—Your correspondent ("Runcorn"), I think, would find creosote do for his purpose; it is used by the Government for melting metal, &c., at Woolwich. The heavy tar oil is burnt in contact with steam, perfect combustion thereby taking place. Should he address himself to me at the Post Office, near Mark Lane, Fenchurch Street, I would give him the necessary information.—R.

Testing Lemon-Juice.—I wish to know what process is followed by analytical chemists in testing concentrated lemon-juice as used by calico printers—viz., to ascertain quantity of citric, tartaric, sulphate, and oxalic acids, chlorides, iron, or any other contaminations contained therein—and should feel obliged if you would, through the medium of your valuable paper, give me the name of some work where I could meet with the information.—A. S.

Bronze for Leather.—Can any of your readers give me the composition of the dye used in giving a rich reddish brown metallic (bronze) appearance to leather? It is altogether a vegetable dye—or, at least, it is either animal or vegetable—because it leaves no residue on combustion. Your correspondent refers to the bronze now so general on ladies' boots and shoes.—A Constant Reader.

Reducing the Metal from Impure Chloride of Zinc.—(Reply to "An Old Subscriber.")—Not having stated what are the impurities, it is somewhat difficult to advise on the subject, but perhaps the following plan will answer:—Make a moderately strong aqueous solution of the chloride; add powdered dry chalk in a very slight excess. You thus obtain carbonate of zinc, while chloride of calcium will be in solution. Wash the carbonate of zinc, dry it, and mix it with powdered charcoal and some crude oil, taking care to have excess, by weight, of the former of these substances. Place this mixture in a fire-clay retort, or apply the well-known English zinc-melting method. You will require a very strong heat. The zinc, being a volatile metal, will distil.

Acacia Charcoal.—Japanese Fireworks.—Acacia charcoal is now given as a medicine, sold at a high price, the vendors averring that acacia charcoal, and acacia charcoal alone, is the only efficacious material; in fact, that no other charcoal "need apply." I doubt this. Will any of your chemico-medical readers kindly give me information. or an opinion on the subject.—The pretty little Japanese fireworks, for which I sent you a formula once upon a time, have frequently failed in the hands of my friends. I find the cause to be the enormous degree of adulteration in the flour sulphur; crystallise this from benzol, and all goes well; in this case, an additional part of sulphur is required. Roll brimstone would probably be pure enough.—R. Trevor Clarke.

Testing Lemon-Juice.—"A. S." is referred to O'Neill's "Chemistry of Calico Printing and Dyeing, &c.," page 140 and following pages.

Glue and Gelatine.—(Reply to "G. G.")—See "Knapp's Technology," English edition, by Dr. Richardson and Mr. Watts; see Wagner's "Hand und Lehrbuch der Technologie," vol. v., p. 80 and following pages.

Mellite or Honeystone is a rather rare mineral, consisting of mellitic acid, alumina, and water; its colour is honey-yellow; it occurs in brown coal in Thuringia, near Bilin, Bohemia, and in a few other localities.

Utilisation of Sulphate of Lime.—(Reply to "Glauber.")—Sulphate of lime, whether it be precipitated, or the native sulphate ground into powder, is useful as a manure by itself. If the article you allude to is very white and pure, it may find a sale among paper-makers.

Bronze for Leather.—(Reply to "A Constant Reader.")—It would be impossible to give you the composition of such a substance as you allude to without actually testing the material; but it is very likely that the substance used is a strong alcoholic solution of aniline purple, which is applied for bronzing purposes.

Acacia Charcoal.—(Reply to R. Trevor Clarke.)—This is probably inferior to willow charcoal; the latter makes a very soft smooth powder, and mixes readily with water. The wholesale price varies from 1s. 4d. to 1s. 6d. per lb. Logwood charcoal has been sold under the name of "the immortal carbon."—G. A. K.

Acacia Charcoal.—(Reply to R. Trevor Clarke.)—You are quite correct as to your surmise concerning acacia charcoal; refer to Pereira's "Materia Medica," 4th edition, vol. i., page 320 and following, Wood charcoal obtained from the lime, or linden tree, *Tilia Europea.*

L., is officinal in some Pharmacopœias. The cause you suggest of the failure of the use of flowers of sulphur is, we think, wrong; the reason is that, unless flowers of sulphur have been washed, they always contain sulphuric acid. Roll sulphur only is used in the powder manufacture for the same reason.

Analysis of Nitrous Oxide.—Happening to meet with a copy of Roscoe's "Elementary Chemistry," and looking over the article "Nitrous Oxide," I find he asserts that, after analysis of the gas by potassium in a bent tube over mercury, the products, after combustion of the metal in the gas, are nitrogen and potassium hydroxide, KHO! Where does the H come out of? Will Professor Roscoe kindly explain this?—VERITAS, Liverpool.

Specific Gravity.—Would you kindly favour me with an answer to the following question:—I read of solutions as being of sp. gr. 1.053, &c. Now what is the rule for determining these strengths by Twaddle's hydrometer; or, in other words, how may I know the rule for calculating these strengths, that when I see the sp. gr. I may calculate them, so as to be able to know at what number of degrees is equal on Twaddle's? I should be glad if you would enlighten me on this point. —CHAS. H. PARKIN.

Electro-Deposition of Copper upon Cast Iron.—In attempting the above, the writer finds great difficulty in obtaining adhesion between the copper and the rough surface of the cast iron, previously cleansed by dilute sulphuric acid. Whether the deposit be made slowly or quickly, it is soon separated from the iron by a black powder, which appears to consist chiefly of carbon, silica, &c. Information, or reference to treatises, will be much esteemed by HISTRIX.

Treatment of Oils for Machinery Purposes.—Can any of your readers supply any information upon the process of refining animal and vegetable oils, having special regard to the abstracting the gummy or albuminous matter, without introducing any acids that would be injurious to the machinery afterwards; or perhaps they could recommend some work which treats on the subject.—B. S.

Gas and Oil Furnaces.—"J. C.," who enquires about gas and oil furnaces, in the CHEMICAL NEWS of September 24th and December 3rd, will find the oils produced in distilling crude anthracene and coal-tar grease from asphaltum to yield him the intense heat he requires, practically free from sulphur and deposit. It could be used in the Siemens regenerative furnace or otherwise.—WM. SCHOFIELD.

Electro-Deposition of Copper upon Cast-Iron.—(Answer to "Histrix.")—Among the many treatises on electro-metallurgy the "Repertorium der Galvanoplastik und Galvanostegie, &c.," von A. Martin, published at Vienna, is one of the best, and contains very ample information on this subject. This work can be inspected at the Patent Office Library.

Specific Gravity.—(Answer to "C. H. Parkin.")—According to Twaddell's scale, 0 is equal to 1000, or the specific gravity of distilled water, and each degree is equal to 0.005; so that by multiplying this number by the number of degrees marked on the scale, and adding 1.0, the real specific gravity is obtained. There are published tabular forms giving the specific gravity for every degree of Twaddell's hydrometer.

Knife-Edges for Balances.—(1) Is a balance with agate edges as delicate in its indications, and as prompt in its action, as one with steel edges? [A balance with agate edges is as delicate in its indications, and as prompt in its action, as one with steel edges.]

(2) Is a balance with agate edges more liable to get out of order? [It is not so liable to get out of order.]

(3) If there be an advantage in the agate above the steel, is it worth the increased cost?—W. H. D. [Steel rusts in a damp atmosphere, or if kept in laboratory. Agate edges are well worth the extra cost.]

Treatment of Oils for Machinery Purposes.—(Answer to "B. S.")—Oils for machinery purposes, and for lubricating generally, may be purified by agitating them with from 4 to 8 per cent of their weight of a caustic soda lye, sp. gr. 1.2. After twenty-four hours' repose, the supernatant oil is decanted from the soapy sediment, thoroughly washed with pure cold water, left to repose, again decanted, and filtered, best through some animal charcoal, such as is used for the filtration of sugar syrups in sugar refineries, and through the woollen tissue, also in use in these establishments. This treatment renders the oils very suitable for the purpose intended, and is quite free from any action on the metals.

Glue and Gelatine.—In reply to the enquiry of "G. G.," he will find every information in the admirable articles "On Gelatine and Glue," in Dr. William Allen Miller's "Elements of Chemistry," where the subject is thoroughly treated. I just add a test for the goodness of glue, which I have found very valuable. Assuming that "that" is the best glue which will take up most water—Take 50 grs. of the specimen, and dissolve it in 3 ozs. of water in a water-bath. When dissolved, set it by for 112 hours, to gelatinise; then take a 1 oz. chip box, place it on the surface of the gelatine, and put "shots" into the box, till it sinks down to a "mark" on the outside. It will be found that, the stronger the glue, the more shots it will take to sink the box down so that the mark shall be level with the surface of the gelatine. In a trial with Mitchell's glue, which is made here, and is the finest I ever met with, 50 grs. of glue, dissolved and gelatinised, with 3 ozs. of water, supported to the mark on the box, 6 ozs. of shots, at a temperature of 58° F. On trying the same experiment with best Russian isinglass, 50 grs., dissolved in 3 ozs. of water, supported 9 ozs. of shots, the temperature being the same. Russian isinglass, therefore, is one-third stronger than glue in gelatinising power; but, as Russian isinglass is worth £3 4s. and best glue is worth but £3, the cwt., there is no fear that the former will ever supersede the latter.—ALFRED BIRD, Birmingham.

Electrotyping Cast Iron with Brass.—Can any of your readers kindly inform me if there is any known method of electrotyping cast-iron with brass?—E. B.

Dissolving Resin in Water.—Will any of your readers kindly inform me whether there is any process by which ordinary resin can be dissolved in water without losing its clearness and natural orange colour; and, if so, what the process is?—J. MILTON.

Analysis of Nitrous Oxide.—(Reply to "Veritas.")—Happening to possess a copy of Roscoe's "Elementary Chemistry," and looking over the article "Nitrous Oxide," I find that he does not assert that, after analysis of the gas by potassium, in a bent tube over mercury, the products, after combustion of the metal in the gas, are nitrogen and potassium hydroxide, KHO; but he says that the products of the combustion are solid potassium oxide, or potash, and nitrogen.—W. K.

Native Carbonate of Baryta.—Will any of your readers kindly inform me, through the medium of your valuable paper, what are the principal applications of native carbonate of baryta, and what is about its market value?—A READER.

[Commercial value, according to purity, from 8s. to 9s. 6d. per cwt. Is applied for the manufacture of salts of baryta, for the preparation of caustic baryta, and also in glass-making.]

Alumina from the Island of Eubœa.—Can any of your correspondents inform me about the "Alumina" obtained from the Island of Eubœa, its price, and through whom it may be obtained. Samples required, which would probably lead to business.—J. B. N.

Dissolving Resin in Water.—(Answer to "J. Milton.")—You cannot dissolve resins in water as you can salt, or sugar, or gum; but shellac, for instance, may be rendered soluble in water by means of a solution of borax, and by means of aqueous solutions of caustic and carbonated alkalies, many (not all) resins may be rendered what can be termed soluble in water; but in reality this is attended with a kind of saponification similar to that which occurs when neutral fats are treated with caustic alkalies, thereby becoming soluble soaps.

ANSWERS TO CORRESPONDENTS.

NOTICE.—The American Publishers of THE CHEMICAL NEWS *give notice that, in accordance with a suggestion of* MR. CROOKES, *the Editor and Proprietor of the English Publication, they will be pleased to receive and forward to him in London any scientific publications issued in America, for review—and also any Notes and Queries, Articles, Correspondence, &c., for publication or reply. Their facilities of communication with* MR. CROOKES *render this very desirable to all persons in the United States who wish to confer with him. Address to him, care of*

W. A. TOWNSEND & ADAMS,
434 Broome Street, New York.

R. K.—Picrate of potash explodes on concussion; detonation is greatly increased by the addition of chlorate of potash.

T. C. Winton, A.B., M.D.—Victoria orange may be obtained of Messrs. Roberts, Dale, and Co., Manchester.

Librum.—Fresenius's "Qualitative and Quantitative Analysis," published by Churchill.

R. H.—Any person can receive fees as an analyst without passing an examination or proving his competency.

Captain Ross, R.A.—We regret that we have no space for your articles. They will be returned to any address you may forward.

John A. R. Newlands, F.C.S.—Declined, with thanks. Such purely theoretical speculations occupy more space than we can now spare.

C. C. T. Tickborne.—Received, with thanks.

A Subscriber.—A work on the subject is in the press. It will be announced in these columns.

Analyst.—Chevreul's work, "On Fats," is very rare; it was published about the year 1828.

Alfred Bird.—Received, with thanks.

A Three Years' Subscriber.—You cannot make an extra strong boiled oil; but the older the oil before it is boiled the better for your purpose.

B. F.—A book treating, among other subjects, on Bleaching of Linen, by the Editor of this paper, is in the press, and will shortly be issued.

L. Nightingale.—Any good work on agricultural chemistry will give you the information you seek.

F. D.—1. The copyright will belong to the proprietor of the magazine, unless you stipulate for its reservation when sending the article.

H. R.—1. Some excellent lectures on coal-gas appeared some little time ago in the CHEMICAL NEWS: consult these. 2. Mulder on the "Chemistry of Beer."

James Wylde's courteous letter in reference to the *Electric Telegraph Review* is received, with thanks, and shall meet with due attention.

R. C. Moffitt, Ph.D.—1. The index is issued with the present number. Its great length and the care required in its preparation have rendered the delay of a week necessary. 2. Browning and Co., Minories, or Horne and Thornthwaite, Newgate Street.

Books Received.—"The Chemistry of Silesian Sugar-Beets," by Dr. Augustus Voelcker. London: W. Clowes and Sons. "The Life and Letters of Faraday," with portrait and woodcuts, by Dr. Bence Jones, F.R.S., &c. London: Longmans and Co. "The Mechanic:" part 21, for December. "A Manual of Diet for the Invalid and Dyspeptic, with a Few Hints on Nursing," by Duncan Turner. London: John Churchill and Sons. "The Development of the Idea of Chemical Composition," by Alexander Crum Brown, M.D., D.Sc. Edinburgh: Edmonston and Douglas. "A Treatise on Asiatic Cholera," by C. Macnamara. London: Churchill.

[English Edition, Vol. XX., No. 525, page 300; No. 526, page 312: No. 527, page 323; No. 523, page 276; No. 524, page 288; Vol. XXI., No. 528, page 12.]

AMERICAN SUPPLEMENT.

New York, February, 1870.

The Purification of Coal Gas, and the Gas Nuisance in New York.

Report of Prof. C. F. Chandler to the Metropolitan Board of Health, of New York.

Colonel Emmons Clark, Secretary of the Metropolitan Board of Health:—

Sir—In answer to the resolution of the Board of Health, directing the chemist to make a statement *in extenso* of the methods of purification employed by the several gas companies of New York, I have the honor to submit the following report:—

I.—METHODS OF PURIFICATION IN GENERAL USE.

The crude gas which is produced by the exposure of bituminous coal to a bright red heat, in clay or iron retorts, is freed, during its passage through the hydraulic main, the condenser, and the washer, from the tar which it contains, and from a portion of its water and ammoniacal compounds. It still contains, however, objectionable impurities, which must be removed by a process of purification. These are sulphuretted hydrogen, sulphide of ammonium, cyanide of ammonium, sulphocyanide of ammonium, bisulphide of carbon, certain other sulphur compounds whose exact nature is not known, and carbonic acid. The sulphur compounds are all very objectionable; they give the gas a very offensive smell, and when burned, produce sulphurous acid, which, if produced in any considerable quantity, would quickly render the air of a room unfit for human life, and seriously injure furniture and goods exposed to its action. These sulphur compounds must therefore be removed. The carbonic acid gas is objectionable only in as far as it diminishes the illuminating power of the gas when present in appreciable quantities. There is no sanitary objection to carbonic acid; for perfectly purified gas would produce, when burned, a great many times as much carbonic acid as exists in the most impure crude gas. The presence of ammonia in gas in appreciable quantities is objectionable; but as all the methods of purification, at present used, remove the compounds of ammonia very effectually, we may confine the discussion to the sulphur compounds and the carbonic acid. There are four methods of purifying gas now in use.

1. *The Wet Lime Process.*

This process involves passing the gas through milk of lime. It is the oldest process in use, and is very effective in removing both the sulphur compounds and the carbonic acid. It has been generally abandoned, however, on account of the difficulty of disposing of the foul milk of lime, called "blue billy." Occurring as a liquid, the "blue billy" is not easily transported; and as it does not rapidly undergo oxidation, it is not well adapted for use as a fertilizer. Running it into rivers and streams has been forbidden by law, as the pollution of the waters by it was intolerable, while the extremely offensive smell which it emits makes it impossible to store it until it becomes dry enough for transportation.

2. *The Dry Lime Process.*

In this process dry or slightly moist hydrate of lime is placed on trays in iron boxes, through which the gas is made to pass. This process is very effective, and has very generally superseded the wet lime process. It removes the sulphur compounds and the carbonic acid equally well. When the foul lime is removed, however, it evolves the same odor which caused the wet lime process to be abandoned. When exposed to the air it rapidly undergoes oxidation, becoming heated in consequence. During this process it evolves sulphide of ammonium and some other compounds whose exact nature is not known, but whose odor is extremely offensive. This is the cause of the "gas nuisance" so loudly complained of a few years ago, when all the New York companies employed this process of purification. After the oxidation of the foul lime is completed it ceases to be specially offensive, the peculiar stench being evolved during the first hour or two of exposure. The offensiveness of this foul lime became such a constant cause of complaint in the large cities of Europe that the gas companies were compelled to abandon the process, as they had previously abandoned the wet lime. A system of ventilating the foul lime has been invented and is now in use at both the stations of the Manhattan Company in this city, which effects its oxidation in such a manner that the offensive gases evolved are not permitted to escape into the atmosphere, but are passed through a washing apparatus and finally through a special purifier, by which they are rendered comparatively inoffensive. This invention seems to obviate the nuisance of dry lime purification.

3. *The Laming Process.*

In 1849 Mr Laming introduced the hydrated sesquioxide of iron as a substitute for lime for purifying gas, preparing it of a suitable quality by mixing copperas (sulphate of iron) with slacked lime and sawdust, and exposing the mixture to the air to oxidize the protoxide of iron to the sesquioxide. The resulting mixture contains hydrated sesquioxide of iron, sulphate of lime, and sawdust.

When an excess of hydrate of lime is employed the resulting mixture contains this substance also. This material is very effective in removing the sulphur compounds from the gas. There is, however, some difference of opinion as to the completeness with which the carbonic acid is removed, due perhaps to variations in the proportions of the ingredients. Two important advantages attend the use of this mixture; first, when fouled it does not evolve offensive odors on exposure to the air; second, by exposure to air the sesquioxide of iron, which has been changed to sulphide of iron in the purifier, is regenerated, the sulphur being liberated and sesquioxide of iron again formed. The mixture may therefore be used again and again, till it becomes so clogged with the sulphur liberated that it does not act promptly on the gas. It is then found to contain from forty to sixty per cent of sulphur, and may be used for the manufacture of sulphuric acid. I have seen mixtures which had been in use twelve months.

4. *The Iron Ore Process.*

A few months after Laming introduced the artificial hydrated sesquioxide of iron in France, Mr. J. M. Hills applied the natural hydrated sesquioxide of iron, or "bog iron ore," in England. This material, like the Laming mixture, may be used again and again, and does not evolve offensive odors when exposed to the air. A modification of this process is now used by the

New York Gas Light Company of this city. It was invented by Messrs. St. John and Cartwright, and has been in use nearly two years, giving entire satisfaction. As the bog iron ores of this neighborhood are not sufficiently pulverulent to act promptly on the gas, Messrs. St. John and Cartwright add to the ore a quantity of iron borings or turnings, which they then convert into an artificial hydrated sesquioxide of iron by moistening the whole with ammoniacal liquor and exposing it to the air. The resulting mixture of natural and artificial oxide receives an addition of coarsely pulverized charcoal. This mixture is always sprinkled with ammoniacal water before it is placed in the purifier.

The material now in daily use at the works of the New York Gas Light Company was introduced in April, 1868. Occasional additions of iron borings have been made to it; otherwise the material is the same. When last tested it contained thirty per cent of sulphur. In Germany several varieties of sesquioxide of iron are now in use, prominent among which are "the Oberuseler mixture," an iron ore containing some oxide of manganese; the "Manheim oxide," and "Deicke's oxide," very pure artificial oxides of iron.

II.—EXTENT TO WHICH THE DIFFERENT METHODS OF PURIFICATION ARE EMPLOYED.

The wet lime method has been almost entirely abandoned. The only works at which I know it to be used at present are at Cork, in Ireland. These works are of moderate size, and are situated out of the city. Moreover, the gas is freed from ammonia by means o sulphuric acid, before it comes in contact with the lime. The foul lime does not, therefore, evolve sulphide of ammonium when exposed to the air. The dry lime process, though still in general use in this country, has been almost universally abandoned in Europe. Abandoned, firstly, because the foul lime was an intolerable nuisance; secondly, because the process is too expensive, as the lime can be used but once, and when exhausted has but a trifling value as a fertilizer.

The Laming mixture is now used in many of the European gas works. All the gas supplied to Paris is purified by this material. The German gas engineers have found that this mixture owes its efficacy entirely to the oxide of iron which it contains, and that the sulphate and hydrate of lime present do not take any appreciable part in the purification. Hence they are abandoning this mixture for the natural or artificial oxides of iron, which are cheaper and more efficient.

The iron ore method is now most generally used in Europe, and has obtained a foothold in this country, being used by the New York Gas Light Company in this city, as already described, and by two or three companies in Massachusetts. All the Liverpool gas, much, if not all, of the London gas, and that of most of the German cities, is now purified either by iron ore or one of the artificial oxides of iron. As my statements with regard to the general use of iron in place of lime were called in question during the hearing before the Board of Health, I will state that they were fully confirmed by my observations in Europe during the past summer, and will quote two or three unimpeachable authorities. Dr. Schilling, director of the gas works at Munich, and editor of the *Journal für Gasbeleuchtung*, says on page 247 of that journal for 1868: "Iron purification is now in general use." Mr. A. Buhe, who was one of the chemists employed by the German Gas Association to investigate the whole subject of gas purification, says, in the above mentioned journal for 1868, page 327 *et sequitur:* "Gas engineers have sought by various means, especially by lime, to remove the carbonic acid from gas; but these have been generally abandoned on account of the cost and the numerous disadvantages which attend their use." . . . . "Purification by lime is hardly in use at the present time." Mr. G. R. Hislop, engineer and manager of the Paisley Gas Works, and President of the North British Association of Gas Managers, stated in his address at Glasgow, July 28, 1869: "Purification by lime in London and elsewhere has now become inadmissible; in such places oxide of iron is employed as the purifying agent."—(*Journal of Gas Lighting*, 1869, p. 695.)

III.—COMPARATIVE ADVANTAGES OF THE DIFFERENT METHODS.

The lime methods effectually remove the carbonic acid, and reduce the sulphur compounds to a minimum. Were there no objections to the use of dry lime on the score of cost or offensiveness, I think this agent would be generally preferred. Lime was first abandoned on account of the nuisance which it occasioned, but the iron oxides are now actually preferred by the European gas engineers on account of their greater economy. Mr. King, the engineer of the Liverpool works, assured me that the oxide of iron purification, which he had used exclusively for the past seven or eight years, cost less than half as much as the dry lime process used previously.

Two objections are urged against the iron methods by those who are prejudiced in favor of lime. First, they do not remove carbonic acid; second, it is claimed that they do not remove the sulphur compounds as completely as lime.

The first is generally conceded to be true. But the only objection to carbonic acid is that it reduces the illuminating power of the gas. One per cent of carbonic acid diminishes the illuminating power five per cent. The average quantity of carbonic acid is, say two and one-half per cent—then the illuminating power of the gas will suffer to the extent of twelve and one-half per cent, or one-eighth.

There are two ways in which this difficulty can be effectually met: First, by using better coals for making the gas, or adding a few pounds of rich cannel or some other enriching material to the ordinary gas coals; or secondly, by taking less gas from the coal. The last gas drawn from the coal is always inferior to that which comes off first. Mr. A. Buhe, already referred to, says: "It has become more and more the custom to leave the carbonic acid in the gas, and to neutralize its bad influence on the illuminating power by taking less gas from the coal, thus getting a better gas." Dr. Schilling says: "Carbonic acid is of no consequence to the consumer; cannel coal is the remedy."

The second objection to the iron processes is the alleged imperfect removal of the sulphur compounds. None of the methods in use entirely remove the sulphur from the gas. The question arises, therefore, how much sulphur can be safely left in the gas. The English parliament has answered this question by fixing the limit at twenty grains of sulphur to 100 cubic feet of gas; and, to see that the companies come within this limit, chemists are appointed whose duty it is to analyze the gas and to report its quality. I have before me the report of Dr. Letheby for the months of January, February, and March, 1869. He states the grains of sulphur found in 100 cubic feet of gas to be as follows:-

	Maximum.	Minimum.	Average.
City of London Gaslight and Coke Company.....	18·92	11·70	15·00
The Gaslight and Coke Co....	24·15	15·75	19·49
Great Central Gas Consumers' Company.....	24·00	7·03	12·28

From this it will be seen that the gas of London, although purified by iron, does not average twenty grains of sulphur in 100 cubic feet. With regard to the Paris gas, which is purified by Laming's oxide of iron mixture, Professor J. Lawrence Smith, one of the United States Commissioners to the French Exposition of 1867, who is the president of the Louisville Gas Company, has given us a very decided opinion. On page 88 of his report, which was published by the United States government, he says: "The gas of these works is most thoroughly purified, and the dealers in silks and other delicate fabrics, who, a few years ago, always suffered more or less loss from the results of the combustion of impure gas acting on their fabrics, now no longer suffer from this cause."

Dr. Letheby (*Journal of Gas Lighting*, 1869, page 83) has argued that twenty grains of sulphur should not be left in the gas, and proposes, therefore, as the most effective method of purifying gas, this treatment: first with ammoniacal liquor; second, with hydrated oxide of iron; third, with dry lime. As the iron will have removed the sulphuretted hydrogen, the refuse lime will not be offensive, while it will effectually remove the carbonic acid. This system of purification will, he thinks, reduce the quantity of sulphur to ten or twelve grains per 100 cubic feet. Most gas engineers and chemists differ from Dr. Letheby on this point, however. Dr. Schilling says in his *Journal für Gas Beleuchtung* for 1869, page 484: "Twenty grains of sulphur in 100 cubic feet of gas are entirely unobjectionable. Under the most favorable circumstances, with no ventilation whatever, it would give the atmosphere of a room only one part of sulphurous acid in 500.000 parts of air." Professor William Odling, secretary of the London Chemical Society, has spoken very clearly on this subject in his lecture to the British Association of Gas Managers, June 2, 1868, which appears in the *Journal of Gas Lighting* for 1869, page 81, and I have found that his views are those generally entertained by chemists and gas engineers. He said:—

"I am altogether at issue with the public when they maintain that the sulphur of gas produces, by its combustion, oil of vitriol, or that the amount of sulphur ordinarily contained in gas is of any consequence whatever; and a little consideration will, I think, satisfy you of the soundness of this position. We will assume that coal gas contains not twenty, but forty grains of sulphur in 100 feet, a quantity, at any rate, greatly exceeding the reality. Now, making another extravagant assumption that the whole of these forty grains of sulphur would be completely burned—and, in reality, they would be burned very incompletely—they would furnish, by their combustion, eighty grains of sulphurous acid gas. This quantity of the produced sulphurous acid would occupy at ordinary temperatures about one-fifteenth part of a cubic foot, and since 100 cubic foot of our coal gas gives one-fifteenth of a cubic foot of sulphurous acid, 1,500 cubic foot of coal gas would be required to furnish one cubic foot of the acid, even upon the extravagant assumptions we have purposely made. But the combustion of 1,500 feet of coal gas would produce something besides sulphurous acid. It would produce at least 1,000 cubic feet of carbonic acid, and, in addition to its dilution by other gases and vapors, we should have our sulphurous acid diluted by 1,000 times its volume of carbonic acid. Now, if we can get at the proportion of carbonic acid in the atmosphere of a room highly illuminated with gas, and take the thousandth part of that proportion, we shall be able to form some notion of the amount of sulphurous acid present. You will remember that the amount of carbonate acid furnished by the breath of one individual is equal to that furnished by two three-feet gas burners, and that the maximum amount of carbonic acid found in the atmosphere of a crowded theatre was 0·32 per cent. Now, if in addition to our previous unreasonable suppositions we further suppose that an atmosphere contains 0·2 per cent. of carbonic acid furnished by gas combustion, you will see that the whole matter becomes a *reductio ad absurdum*—that we might actually have one-half millionth part of sulphurous acid present in the air of a gas-lighted room."

I think that the facts and opinions here quoted effectually dispose of the second objection to oxide of iron purification. It may seem that I have said more than was necessary on the comparative merits of the lime and iron processes of purification, but a perusal of the testimony given during the hearing before the Board will recall the fact that the evidence of the experts, called by the Metropolitan Gaslight Company, was almost entirely confined to this question. In fact, the defence offered was the alleged total failure of the iron processes, and the consequent unavoidable use of lime.

(To be concluded in the next number.)

The Various Methods for the Determination and Separation of Baryta, Strontia, and Lime. Also some Remarks on the Precipitation of Sulphuric Acid by Salts of Baryta.

By Paul Schweitzer, Ph.D.

I.—*Determination of Baryta.*

Baryta may be precipitated from its solutions in either of the following forms; viz, as sulphate, chromate, or carbonate of baryta or silico-fluoride of barium. The sulphate is generally considered as giving the most accurate results, and the others are seldom employed except in special cases. There are precautions to be observed in the precipitation of the alkaline earths, the neglect of which will lead to more or less inaccurate results, on account of their precipitates, and particularly their sulphates, carrying and retaining alkaline salts with so strong an affinity as to require a special treatment to free them entirely from the same. The amount of alkali retained in this way varies somewhat, according to the treatment of the precipitate in question; and although in ordinary determinations of alkaline earths the results are not much affected, the error, in more accurate researches, and in the determination of sulphuric acid by a salt of baryta, will be large enough to cause material inaccuracy and inconvenience.

Sulphate of Baryta.

For the determinations of baryta, pure crystallized chloride of barium was used, which had been heated for some time at a strong red heat. It loses its water with difficulty, and, with the last traces of it, some hydrochloric acid. It should be then mixed with dry chloride of ammonium, and heated until all ammoniacal salts are volatilized, when it will dissolve to a clear

solution in water. For the three following determinations this anhydrous chloride of barium was dissolved in water, and the solution precipitated with a slight excess of dilute sulphuric acid—A in the cold, B in the cold after acidulating with hydrochloric acid, and C boiling hot after acidulating with hydrochloric acid in the same way. The supernatant liquid in C, after standing, was decanted, and the precipitate boiled with dilute hydrochloric acid and water; after decanting a second time this boiling was repeated, and all three precipitates brought then upon their respective filters, and washed—A and B with cold, and C with hot water. C was washed out first, next B, and lastly A. No hydrochloric acid could be detected in the last filtrates.

	A.	B.	C.
BaCl used.....	1·8230 grms.	1·4716	2·2560
BaO,SO_3, found.	2·0375 grms.	1·6470	2·5210
BaCl calculated from last....	1·8260 grms.	1·4697	2·2496
BaCl.....	100·16 p.c.	99·87 p.c.	99·71 p.c.
	+0·16 p.c.	−0·13 p.c.	−0·29 p.c.

The sulphate of baryta will best subside when precipitated from a hot solution, and can then be washed very easily. If it is, however, precipitated in the cold, it requires some time, often 24 hours, before it has completely separated and settled. This fact must especially be borne in mind, when very small amounts of baryta have to be separated from large quantities of other salts, as is the case in the analysis of some mineral waters, iron ores, etc. The same precautions must be observed in the precipitation of sulphuric acid by means of a salt of baryta. It would appear as though there was at first formed an amorphous sulphate of baryta, which, like the carbonates of the alkaline earths, when precipitated from concentrated solutions is hydrous and somewhat soluble in water, and becomes insoluble, heavy, and crystalline only by losing its water.

The results of the above determinations are satisfactory, yet the solution should not contain too much free acid, as in that case, upon the repeated treatment, more than a mere trace of the precipitate will be dissolved. When, however, baryta is to be precipitated from a solution containing alkaline salts, a more or less considerable amount of the salts will always be carried down with the sulphate of baryta, and which under no conditions can be washed out from it. Where there are only trifling amounts of alkaline salts in a solution, large dilution with acidulated water before precipitation may answer; the error, however, will amount to about 1 p.c. of the calculated chloride of barium present, and will be greater when small quantities of baryta or sulphuric acid have to be determined in this way. The removal of the retained alkalies in such cases can only be effected by dissolving the precipitate of sulphate of baryta in concentrated sulphuric acid, which can easily be accomplished in a platinum dish with the application of heat, and precipitating again with water. Sulphuric acid in such cases takes the place of the alkaline salt. In fact sulphuric acid adheres to the sulphate of baryta always, even when the filter has not been carbonized by not washing completely, and can be easily detected upon igniting a dried precipitate of sulphate of baryta. Boiling with hydrochloric acid, as has been proposed, is unavailing, as can be seen by comparing Analysis C with A, B and B_2.

For the following four analyses the chloride of barium was dissolved in water, and mixed in each case with 3 grms KCl and 3 grms. NaCl, and the solution precipitated with a slight excess of dilute sulphuric acid—A in the cold, B_1 and B_2 in the cold after acidulating with hydrochloric acid, and C boiling hot after acidulating in the same way. The precipitated sulphate of baryta in C was boiled twice with dilute hydrochloric acid and water, as described before, and all four precipitates then brought upon filters and washed, A, B_1 and B_2 with cold, C with hot water, until no hydrochloric acid could be detected in the filtrates, and a large quantity of the wash-waters left no residue upon evaporation.

The amount of fluid in B_1 was 330 c.c., of wash-water 430 c.c.; the amount of fluid in B_2 was 1730 c.c., of wash-water 190 c.c. In all four precipitates soda as well as potassa could be detected by the spectroscope.

	A.	B_1.
BaCl.....	2·0875	1·4860
BaO,SO_3.....	2·3795	1·6840
BaCl.....	2·1234	1·5027
	101·72 p.c.	101·12 p.c.
	+1·72 p.c.	+1·12 p.c.

	B_2.	C.
BaCl.....	+1·3934	2·2655
BaO,SO_3.....	1·5780	2·5650
BaCl.....	1·4081	2·2880
	101·05 p.c.	101·03 p.c.
	+1·05 p.c.	+1·03 p.c.

Long continued washing with or without addition of hydrochloric acid does not, therefore, remove the alkalies from the precipitated sulphate of baryta, and the only way which was found effectual for this purpose was to dissolve it in concentrated sulphuric acid. The sulphate of baryta, thus treated, washed, and ignited, will hardly show any traces of alkalies before the spectroscope, and represents the exact amount of baryta salt present.

Of the sulphate of baryta of B_1, 1·6730 grms. were treated in the manner above described. As it contained 1·12 p.c. of alkalies, they correspond to

1·6543 grms. BaO,SO_3 (0·0187 gr. alkalies).
1·4762 " BaCl.

The sulphate of baryta, precipitated from its solution in concentrated sulphuric acid, amounted to

1·6530 gr. BaO,SO_3
1·4751 gr. BaCl
99·93 p.c.
−0·07 p.c.

Determination of Sulphuric Acid.—In order to determine the character of the affinity of sulphate of baryta for alkaline salts, some experiments were made in an opposite direction by precipitating sulphate of soda and potassa with an excess of chloride of barium. By thoroughly washing the precipitates of sulphate of baryta obtained in this way, either with (A.) or without (B.) the addition of hydrochloric acid, the excess of chloride of barium is first washed out, together with the chlorides of the alkalies present. By continuing the washing longer, sulphuric acid appears in the filtrate (to be detected by chloride of barium), which requires much water and a long time to remove completely. The appearance of sulphuric acid in this place is owing to a decomposition of a compound of sul-

phate of baryta with the sulphate of an alkali. It is apparent, therefore, that in such a case the source of error may be twofold; firstly, by losing sulphuric acid in the way indicated, and by retaining sulphuric acid in the form of a sulphate of an alkali. These two errors apparently compensate each other sufficiently for practical purposes. Scientific investigation must, however, as much avoid the one as the other.

A	B
3·2133 gr. NaO,SO_3	4·1824 KO,SO_3
5·2735 BaO,SO_3	5·5580 BaO,SO_3
3·2139 NaO,SO_3	4·1559 KO,SO_3
100·02 p.c.	99·36 p.c.
+0·02 p.c.	−0·64 p.c.

A very large amount of water was necessary in these two analyses, to remove the alkali. But, after igniting the precipitates, soda as well as potassa could be detected in them by the spectroscope. The wash-waters, therefore, should be preserved, and any precipitate which may have formed by long standing be filtered out. Both precipitates of sulphate of baryta should then be dissolved in concentrated sulphuric acid, and, after again precipitating, weighed. The wash-waters may be evaporated for the determination of alkali, if necessary.

If the amount of alkali retained by sulphate of baryta be about 1·12 p.c. of the weight of the chloride, we will have lost in A 1·10 p.c. and in B 1·76 p.c., showing that more of the sulphate of potassa is retained as such than of the sulphate of soda; and by long washing and decomposing such a compound we lose, of course, more of the former than of the latter.

All the precipitates of baryta which are produced by an excess of sulphuric acid must be washed completely, otherwise the filter paper will be charred on drying, on account of a small quantity of sulphuric acid which is retained, as has been previously stated.

Chromate of Baryta.

The chloride of barium used for the following determinations was dissolved in water, and precipitated, in A, with a solution of chromate of ammonia, in B with a solution of chromate of potassa, with the addition of a little ammonia to render the solution alkaline. This method will give good results, but is notwithstanding, almost impracticable, on account of the difficulty of obtaining chromates that are free from sulphuric acid. A previous partial precipitation with a salt of baryta will, however, remove all sulphuric acid, yet the principle must necessarily be objectionable in a strictly scientific point of view. This method is, therefore, only practicable for the determination of chromic acid, which in small quantities in certain ores can be very accurately estimated in this way. The chromate of baryta will hold alkalies, if there are any in solution, but much less so than the sulphate.

The precipitates, after standing for 24 hours, were filtered on a weighed filter and washed with cold water, until no hydrochloric acid could be detected in the filtrate. The wash-waters showed a trace of baryta with dilute sulphuric acid, after standing for some time.

A	B
2·0020 BaCl	1·3960 BaCl
2·4435 BaO,CrO_3	1·7090 BaO,CrO_3
2·0040 BaCl	1·4020 BaCl
100·10 p.c.	100·43 p.c.
+0·10 p.c.	+0·43 p.c.

Carbonate of Baryta.

The chloride of barium was dissolved in water, and, with the usual precautions, precipitated with carbonate of ammonia, to which some free ammonia had been added. A and D were precipitated in the cold and washed with cold water. B and C were precipitated hot and washed with hot water. 3 grms. of KCl and 3 grms. of NaCl were respectively added to B, C, and D before precipitation. The washing was continued until no traces of hydrochloric acid could be detected in the filtrates. All the precipitates were amorphous and heavy, at first separating in the form of hydrates, but losing the water gradually by washing. The wash-water from A showed traces of baryta after standing twenty-four hours. The hydrous condition of these, and in fact of all the precipitates of baryta, is always an indication of their retaining alkaline salts. The amount of alkali retained by the carbonate of baryta, though at first very much larger than the amount retained by the sulphate, can be greatly reduced by long continued washing.

A	B
1·8705 BaCl	1·0055 BaCl
1·7705 BaO,CO_2	0·9573 BaO,CO_2
1·8685 BaCl	1·0104 BaCl
99·89 p.c.	+100·49 p.c.
− 0·11 p.c.	+0·40 p.c.

C	D
1·8435 BaCl	1·8035 BaCl
1·7566 BaO,CO_2	1·7205 BaO,CO_2
1·8540 BaCl	1·8159 BaCl
100·57 p.c.	100·69 p.c.
+0·57 p.c.	+0·69 p.c.

Silicofluoride of Barium.

This method can only be used in special cases, as most of the salts of the alkalies and alkaline earths are insoluble, or very sparingly soluble in alcohol, and those that are soluble act as solvents for the silicofluoride of barium.

The neutral, or slightly acid solution of the baryta salt is mixed with pure hydrofluosilicic acid and about the same volume of alcohol. After standing for about twelve hours, the precipitate is filtered on a weighed filter, washed with a mixture of equal parts of alcohol and water, until the reaction ceases to be acid (this would not be sufficient when alkalies are present), and dried 100° C.

Only one analysis was made—the insolubility of the alkalies in alcohol, preventing an investigation of the affinity of the silicofluoride of barium for their salts.

1·8205 BaCl
2·4500 BaF,SiF_2
1·8160 BaCl

99·75 p.c.
— 0·25 p.c.

Oxalate of Baryta.

In order to determine whether oxalate of baryta likewise contained alkaline salts, if precipitated under similar conditions, some experiments were made with this salt. With this design, chloride of barium, dissolved in water, was precipitated with oxalate of ammonia, with the addition of some free ammonia. A, without, B and C with, previous addition of 3 grms. KCl

and 3 grms. NaCl. The baryta precipitate is more soluble than the corresponding lime salt, and as crystalline as the latter, if precipitated from dilute solutions, where it will form only after some time, quicker after heating; but voluminous when precipitated from concentrated solutions. The washing was continued until all hydrochloric acid had been removed, the washwaters then containing much baryta.

A	B	C
1·6965 BaCl	1·9605	1·7135
1·5700 BaO,CO_2	1·8340	1·5967
1·6670 BaCl	1·9356	1·6852
97·68 p.c.	98·28 p.c.	98·35 p.c.
— 2.32 p.c.	— 1·72 p.c.	— 1·65 p.c.

I find it in these cases better to weigh as carbonate than caustic baryta, a longer and higher heat being required to expel carbonic acid from baryta than from lime.

By comparing these analyses, it will be seen that about one-half per cent of alkali will be retained by the oxalate. But I do not doubt that the oxalate, as well as the carbonate of baryta, can be freed entirely from the alkaline salts by washing; probably owing to their condition, in which state the compound of alkaline earth with alkali can be easier acted upon by the washwater.

(To be concluded in our next number.)

Dangerous Kerosene.

We continue to record the casualties which result from the sale and use of dangerous kerosene, in the hope that, by warning the public against all the products of petroleum which are unsafe, we shall contribute to drive them from the market entirely.

In New York, the North-German brig *Der Fleiss*, which was anchored opposite Quarantine landing, blew up, and burned to the water's edge. She was loaded with a cargo of naphtha, and bound to Spain. The captain, mate, and cabin-boy were considerably burned, but saved themselves, with the rest of the crew, by jumping overboard.

On the evening of December 10th, Margaret Gallagher was fatally burned by the explosion of a can of "Union oil," at 117 Charles street. She survived only twenty-four hours. The coroner's jury rendered a verdict censuring Mr. Rappelye for selling the oil—rather mild punishment for his part in the kerosene murder. He promised not to sell any more of the dangerous compound.

At the corner of Av. A and 19th street a barrel of kerosene was ignited by the upsetting of a lamp, setting the house on fire, and causing some damage.

Francisco Berryman, aged 21 years, died December 23d, at 53 Eldridge street, from burns occasioned by the explosion of a kerosene lamp.

On the evening of December 23d, a fire broke out at 336 Columbia street, caused by the spilling of a villanous burning fluid called "new gas." It took fire from a candle, blazing up in the face of the woman who held it. The building was damaged to the extent of $1,500; the next house, $1,000.

In Jersey City, Mrs. Emma Sandburger was engaged in filling a lamp, when some of the explosive fluid dropped upon the stove and ignited. The flames communicated to the can containing the liquid, and this exploded. She was fatally burned, and her daughter, in endeavoring to smother the flames, was badly burned.

On December 14th an explosion of naphtha occurred in Boston, severely injuring U. S. Drake, manufacturer of portable gas machines, and slightly injuring several of his workmen.

A disastrous fire broke out at Jackson, Mich., on the evening of December 31st. It originated from an attempt to draw gasoleue near a lamp. Loss estimated at $200,000.

Fire Marshal Brackett reports 31 of the 311 fires which occurred in Brooklyn last year, or 10 per cent., to have been caused by kerosene. The number in New York was 98 in 913, or a little more than 10 per cent.

Gen. Alexander Shaler, President of the Metropolitan Fire Department, says, in a letter to the *New York Times:* "Among the thousand and one causes of fire in our city, the use of inferior kerosene oil is probably the most frequent, and seems likely to remain so until another equally economical, but less dangerous article is furnished for the use of the masses, or a law enacted and enforced which shall hedge it around with such safeguards as will secure immunity from accidents. But I apprehend no law can be enforced which will make careless persons careful. The only way, therefore, to reduce the chances of fires from the use of inflammable oils, is to convince the dealer that 'honesty is the best policy,' and the most profitable one for him to pursue, by inflicting severe penalties for exposing for sale an article that vaporizes below 100° Fahrenheit. The Commissioners have done and are now doing everything in their power to prevent the sale of oils which do not come up to the standard required by law. But the law is found to be defective in its operation; and it is hoped that the incoming Legislature, upon having their attention called to it, will make such enactments as will render the use of inflammable oils comparatively safe."

The *New York Times* protests against the transportation into the heart of the city of car loads of crude petroleum.

On December 8th, Dr. Harris, the Sanitary Superintendent, reported to the Board of Health the results of the kerosene examinations for the previous two weeks. Of 40 samples examined, not one came up to the standard of safety required by law, viz.: *Flashing point*, 100° *F.*; *burning point*, 110° *F.*

The City Court has decided all the kerosene cases against the Board of Health; so dealers may sell liquid gas and dangerous kerosene, and murder housemaids and children with impunity—at least till the case can be carried up to a higher tribunal, which will be done as soon as possible.

Recent Chemical Patents.

Issued November 23, 1869.

97,059.—Apparatus for obtaining Extractive Matters from Sugar-Cane, and other Materials.—L. A. de Lime, St. Louis, Mo.

97,143.—Process of Brewing Beer.—C. Abresch, New York.

97,145.—Curing and Preserving Fish.—R. A. Adams, Cambridge, Mass.

97,182.—Mode of Recovering the Spent Acid from Oil-Refineries.—L. S. Forbes, New York.

97,220.—Manufacture of Soap.—N. Orcutt, Syracuse, N.Y.

97,262.—Lubricating Compound.—C. S. Moore, Erie, Pa.

Issued November 30, 1869.

97,365.—Mode of Producing White Lead.—J. G. Dale and E. Milner, Warrington, England.

97,417.—Metallic Solution for Coating Iron and Steel.—A. A. Lothrop, Neponset, Mass.

97,454.—Dissolving Xylodine for Use in the Arts.—D. Spill, Hackney, England.

97,457.—Apparatus for Generating and Carburetting Illuminating Gas.—A. Stevens, Fitchburg, Mass.

97,469.—Compound for Disinfecting and Deodorizing.—H. G. Dayton, Dayton, Ohio.

Issued December 7, 1869.

97,486.—Compound for Lining Textile Hose.—J. Dollmann and F. W. Claessens, Boston, Mass.

97,497.—Process of Dyeing Black.—J. Gee, West New Brighton, N.Y.

97,528.—Mode of Preparing Paper for Printing Postage and Revenue Stamps.—S. Lenher and H. H. Spencer, Philadelphia, Pa.

97,566.—Explosive Compound for Use in Fire-Arms, Blasting, etc.—T. Taylor, Washington, D.C.

97,567.—Gunpowder.—T. Taylor, Washington, D.C.

97,580.—Generating Hydrogen and Hydrocarbon Gas.—J. S. Wood, Philadelphia, Pa.

97,582.—Manufacture of Steel.—I. Amsterdam, New York.

97,597.—Process of Treating Asphaltum to Obtain Colors and Dyes.—J. Brouner and H. Gotzkow, Frankfort-on-the-Maine, Prussia.

97,607.—Process for Decorative Oil-Painting.—P. Cousin and P. Oury, Paris, France.

97,612.—Mode of Generating Illuminating Gas.—A. Hamar, Philadelphia, Pa.

97,657.—Mode of Preventing Corrosion in Pipes, Bolts, and Similar Articles of Iron in Sea-Water.—R. Lichthal, Brooklyn, N. Y.

96,692.—Manufacture of Soap.—W. P. Pugh, High Point, N.C.

97,718.—Manufacture of Iron and Steel.—H. Spencer and L. K. Taylor, Philadelphia, Pa.

Issued December 14, 1869.

97,754.—Mode of Treating Conglomerates of Cast-Iron.—T. Blair, Pittsburg, Pa.

97,761.—Reducing Ores.—T. J. Chubb, Williamsburg, N.Y.

97,771.—Manufacture of Glue.—G. Goenther, Chicago, Ill.

97,838.—Silvering Glass, and Protecting the Same.—H. B. Walker, New York.

97,844.—Apparatus for Purifying Iron.—S. M. Wickersham, Allegheny, Pa.

97,880.—Manufacture of Rubber Sponge.—E. Chesterman, Tremont, N.Y.

97,889.—Treating Whiskey and Other Alcoholic Spirits.—J. C. Crosman and O. Marland, Boston, Mass.

97,897.—Manufacture of Iron and Steel.—W. Ennis, Philadelphia, Pa.

97,936.—Manufacture of Dry White Lead.—G. T. Lewis, Philadelphia, and E. O. Bartlett, Birmingham, Pa.

97,939.—Fertilizer or Guano.—O. Lugo, Baltimore, Md.

97,941.—Manufacture of Ultramarine.—H. A. Ludwig, New York.

97,949.—Galvanic Battery.—J. R. McPherson, Beloit, Wis.

97,972.—Composition Metal for Tubing, Pipes, and Sheeting.—W. A. Shaw, New York.

97,983.—Water-Proofing Fabrics.—J. Stenhouse, London, England.

Reissues.

90,549, reissue 3,742.—Apparatus for Drying Sugar and other like Articles.—G. A. Jasper, Charlestown, Mass.

90,644, reissue 3,748.—Apparatus for Generating and Carburetting Gas.—C. F. Dunderdale, New York.

94,805, reissue 3,752.—Composition of Liquids for Tanning.—J. Wood, Woodstock, Vt.

Issued December 21, 1869.

98,046.—Vaporizing Petroleum, &c.—H. R. Foote, Boston, Mass.

98,110.—Electro-Plating with Brass and Other Alloys.—S. Rust, Jr., Cincinnati, Ohio.

98,118.—Gas Generator and Carburetter.—A. Stevens, Fitchburg, Mass.

98,139.—Apparatus for the Manufacture of Iron and Steel.—C. Adams, Philadelphia, Pa.

98,155.—Process of Treating Wines, Beer, and Liquors.—J. O. Donner, Jersey City, N. J.

98,165.—Process of Purifying and Decolorizing Albumen from Blood.—P. Jacques, Paris, France.

98,173.—Composition for Preventing Incrustation in Steam-Boilers.—G. W. Lord, Philadelphia, Pa.

98,210.—Manufacture of Paper-Pulp from Wood.—G. Vining, Pittsfield, Mass.

Issued December 28, 1869.

98,285.—Apparatus for Bleaching and Defecating Cane-Juice.—J. C. Marsh, Alexandria, La.

98,336.—Enamelling Iron and Steel.—B. Baugh, Chadwick, England.

98,343.—Apparatus for Filtering Volatile Liquids.—W. Boyce, Tuscola, Ill.

98,354.—Plating Iron for the Manufacture of Hinges, &c.—J. J. Crooke, Southfield, and Lewis Crooke, New York, N. Y.

98,364.—Manufacture of Sheet-Iron.—W. Fields, Wilmington, Del.

98,382.—Nitro-Glycerine Compound for Blasting.—J. Horsley, Cheltenham, England.

98,387.—Bleaching Cotton and Woollen Fabrics.—J. Jeaning, Plainville, Conn.

98,425.—Manufacture of Nitro-Glycerine.—T. P. Shaffner, Louisville, Ky.

98,426.—Process of Preserving Nitroleum and Other Explosive Liquids.—T. P. Shaffner, Louisville, Ky.

98,427.—Explosive Compound.—T. P. Shaffner, Louisville, Ky.

98,428.—Blasting Fuse.—T. P. Shaffner, Louisville, Ky.

98,442.—Apparatus for Producing and Carburetting Hydrogen Gas.—J. H. Steiner, Philadelphia, Pa.

Reissues.

88,208, reissue 3,775.—Manufacture of Iron and Steel.—J. Ralston A. L. Thomas, and W. Parkinson, Philadelphia, Pa.

77,304, reissue 3,777.—Preparing Compounds Containing Collodion.—J. A. McClelland, Louisville, Ky.

77,304, reissue 3,778.—Material for Turning Dental Plates.—J. A. McClelland, Louisville, Ky.

73,000, reissue 3,779.—Carburetting Air for the Production of Light and Heat.—B. Pilkington, Oakland, Cal.

NEW PUBLICATIONS.

ACROSS AMERICA AND ASIA. Notes of a Five Years' Journey Around the World, and a Residence in Arizona, Japan, and China. By Raphael Pumpelly, Professor of Mining at Harvard University, and some time Mining Engineer in the service of the Chinese and Japanese Governments. Large octavo, 454 pp. New York, 1870.

PROF. PUMPELLY has already recorded his scientific observations in a volume of "Geological Researches in China, Mongolia, and Japan," published by the Smithsonian Institution. The book before us is a narrative of the author's journey around the world in the Northern temperate zone. It consists of a series of sketches of the countries and the people visited, is illustrated by engravings and maps, and is full of incident and adventure. It is altogether a very interesting book, and its appearance at this time is specially opportune, when those Eastern nations seem just ready to shake hands with us across the Pacific; and are, perhaps, destined to play a very important part in the development of the nation which is springing up at the further end of the Pacific Railroad.

THE MANUFACTURER'S REVIEW AND INDUSTRIAL RECORD. Edited by Isidor Walz, Ph.D., New York.

This is a very well conducted monthly journal, devoted to textile interests; dyeing, calico printing, etc. The editor is an accomplished chemist, and cannot fail to contribute much valuable instruction to his readers who are specially interested in the subjects to which the paper is devoted. We hail the appearance of every new technical journal published in this country as a new indication that manufacturers are learning to appreciate scientific instruction. The truth is, they are learning that they cannot keep pace with their competitors, except by invoking all the aid that science can afford.

We notice an increasing demand for chemists to take positions in manufactories, print-works, iron-works, sugar refineries, etc. We are moving in the right direction, and shall be ready for free trade one of these days.

CHLOROFORM; AND A NEW METHOD OF ADMINISTERING IT. By A. M. Rosebrugh, M.D., Surgeon to the Toronto Charitable Eye Dispensary. New York: Wm. Wood & Co., 61 Walker st.

This is a handy little pamphlet of 32 pages, containing directions for testing the purity of chloroform; also giving its well-authenticated therapeutical properties, with statistics of deaths caused by its incautious use; the signs of danger are pointed out, together with the most approved means of resuscitation; and finally the author gives a new method of administering this anæsthetic.

MR. EDWARD C. H. DAY, of the School of Mines of Columbia College, contributes an excellent article to the American Educational Monthly for January, on *Minerals, Plants, and Animals, as objects of Popular Education.* Mr. Day has been very successful in his lectures on Natural History to the New York teachers, and has awakened a great interest in the study of Nature.

ON THE SIMULTANEOUS OCCURRENCE OF A SOLUBLE LEAD SALT AND FREE SULPHURIC ACID IN SHERRY WINE; WITH OBSERVATIONS ON THE SOLVENT ACTION OF ALCOHOLIC SALINE SOLUTIONS UPON SULPHATE OF LEAD. By Prof. Frank H. Storer, Professor of Chemistry in the Technological Institute at Boston; a paper read before the American Academy of Arts and Sciences, Oct. 13, 1868. 7 pp.

An account of some interesting and important observations and experiments on the action of acetates, tartrates, citrates, oxalates, succinates, and sugar upon sulphate of lead.

THE AMERICAN GROCER. A semi-monthly journal, published by John Darby & Co., New York.

It contains much valuable information with regard to almost every variety of food and drink.

DIE CHEMISCH-TECHNISCHEN MITTHEILUNGEN DES JAHRES 1868-'69, VON DR. L. ELSNER. Berlin, 1870. A very valuable contribution to technical literature. B. Westermann & Co., 471 Broadway, New York.

BIBLIOTHECA HISTORICO-NATURALIS, PHYSICO-CHEMICA ET MATHEMATICA. A classified catalogue of all books on Natural History, Chemistry and Mathematics, published in 1869, from Jan. to June. B. Westermann & Co., 471 Broadway.

BIBLIOTHECA MECHANICO-TECHNOLOGICA ET ŒCONOMICA. A classified catalogue of all books on technical chemistry, etc., published in 1869, from Jan. to June. B. Westermann & Co., 471 Broadway.

ON THE MAGNETITE IN THE MICA OF PENNSBURY, PA.; in reply to Prof. G. Rose. By James D. Dana and George J. Brush. Extract from the *American Journal of Science and Arts* for Nov.

PROF. G. ROSE considers the dendritic markings in the Pennsbury mica to be due to *hematite*, while Profs. Dana and Brush have pronounced them to be *magnetite*. The weight of evidence is decidedly on the side of magnetite.

BREVITIES.

Report of the Commissioner of Mining Statistics.—Mr. R. W. Raymond, Commissioner of Mining Statistics, has prepared a summary of his annual report. His principal work during the past six months has been the collection of informat on regarding new enterprises, and the condition and prospects of the industry in the different districts, and statistics of production. The principal mining and commercial centres of Colorado, Utah, Nevada, California, Oregon, and Idaho have been visited, and operations therein carefully noted.

The Commissioner reports that the product in California for the year will certainly fall below that of last year, on account of the extraordinary drought which put an end to the placer and hydraulic mining of the northern counties very early in the season. Another temporary cause of decreased production was the stoppage of several important mines in the foremost quartz-mining district of the State—Grass Valley—on account of a miners' strike. In Nevada the yield of the Comstock mines has been largely reduced this year by the exhaustion of various old workings upon which some of the companies have been relying, but especially by the disastrous fire in the Crown Point, Kentuck, and Yellow Jacket, which has interfered with the production of those important mines. The prospects of this district for the future, however, are considerably brighter than they were a year ago.

This year's product of bullion from Nevada will probably not fall far behind that of 1868, the deficiency from Washoe being made up by the greater yield of White Pine. On the whole the prospects of the State have improved, especially in view of the late discoveries in depth on the Comstock lode, the completion of the Pacific Railroad, and the gradual introduction of cheaper labor, particularly of Chinese, into the mines.

In Oregon the product of gold during the past season has been unusually small, since very little quartz mining is now carried on in the State, and the placer and hydraulic mines have stood still nearly all summer for the lack of water.

In Idaho the same causes which have affected the placer mines of Oregon, will render this year's product of gold comparatively small; but the results of quartz mining in the Owyhee and other districts will probably not fall short of last year. The drought has also extended into Montana, and a decrease in the yield from the hitherto so productive gulches is anticipated.

The Commissioner is of the opinion that Colorado is destined to advance henceforth with great rapidity toward wealth and power. The yield of the mines for 1869 is highly encouraging in view of the fact that it is the product of steady industry, and not the first fruits of a speculative activity, which might be expected to die out at an early day.—*N. Y. Evening Post.*

Nitroglycerine.—The Giant Powder Mills, situated in the suburbs of San Francisco, exploded on the evening of Nov. 26th. The building was blown to pieces, the glass in the neighboring houses was shattered, and the explosion was felt for a great distance. Dr. Cusemaus, the chemist and superintendent, was instantly killed. Two other white men were killed, and eight Chinamen were injured. The cause of the disaster is unknown. A considerable quantity of nitroglycerine was stored in the building. Giant powder is a mixture of nitroglycerine and infusorial silica.

An Explosion of Nitroglycerine occurred at the Hoosac Tunnel, on Saturday, Oct. 9th, by which three men were killed. The building in which the dangerous compound was stored was destroyed. On Monday night, Dec. 13th, during the ten o'clock shift of workmen at the Hoosac Tunnel, one of them spilled some nitroglycerine on the rocks, and, while removing the fragments after a blast, an explosion occurred, killing one man and severely injuring three more.

At Titusville, Pa., on December 16, a tremendous shock was caused by an explosion of the magazine of the Roberts' Torpedo Company, containing half a ton of nitroglycerine. The cause of the explosion is unknown. P. H. Brophy, the agent, and another man, who was near the magazine at the time of the explosion, were instantly killed. Considerable damage was done to the buildings throughout the city. The magazine was situated a mile from the city.

Lyceum of Natural History.—At the monthly meeting of the Chemical Section of the Lyceum of Natural History, on Monday evening, November 8th, President Newberry in the chair, several papers were introduced, the first of which, "On Hydrogenium," by Mr. A. B. Gallatin, deserves special mention, as it gave a synopsis of the last great effort of the dying Graham to establish the metallic nature of hydrogen. Several distinguished chemists had already turned their attention in the same direction, and Faraday's apparatus may still be seen at the Royal Institution of Great Britain. No one, however, had succeeded in proving experimentally the truth of the general supposition as to the nature of hydrogen. It was clear to Graham's mind that active hydrogen alone (that is, hydrogen in the nascent state) could be made to combine with other metals; and that, by decomposing an alloy thus obtained, the nascent state of the hydrogen while in the act of leaving the other metal would decide the long-pending question. Nascent hydrogen would prove that it came from a true chemical compound, and, in the case of a metal, from a true alloy; and, consequently, that it possessed the properties of a metallic element. The decomposition of water by means of an electric battery was most naturally employed as a source of nascent hydrogen, and by placing at the electro-negative pole various metals as electrodes, the conditions were most favorable to the success of the experiment. It was, however, by employing palladium that the expected result was obtained, that metal occluding, as it were, the hydrogen, and absorbing it to such an extent that none escaped until the palladium was completely saturated with it. The experiments proved that palladium takes up 936 volumes of hydrogen, and expands 47·68 per cent., or sixteen times as much as when heated from 0° to 100° C. By this wonderful property palladium is widely separated from all the other metals, platinum holding a position about midway between it and the other metals. The next step was to seize upon the hydrogen of the new compound and establish its activity, thus demonstrating that solidification of the hydrogen and not mere absorption or surface action is the cause of the altered appearance of the palladium. The great importance of this was evident to Graham, and, in connection with Mr. Roberts and Mr. Matthiessen, both skilful experimenters, he endeavored without success, by chemical means, to establish the activity of the hydrogen. Yet by reversing the electrical current, or by employing a piece of charged palladium as the electrode, on the electro-positive pole, no oxygen was seen to escape; thus proving the active state of the hydrogen, by immediately combining with the active oxygen, and forming water. Mr. Matthiessen was led to the same conclusion by a microscopical examination. A magnifying power of 500 to 600 diameters exhibited a slightly soiled palladium wire—soiled, perhaps, by merely touching it with the fingers—as having hills and valleys, like the moon as seen through an eight-inch refractor. A wire charged with hydrogen showed a smooth, even surface, with occasional hills, a diagonal cross section having the appearance of a layer of parallel wires; and on looking at the same wire, after expelling the hydrogen by heating it by means of a spirit-lamp, it presented the appearance of innumerable shreds, into which it seemed to have been torn by a violent internal explosion. The next paper was "On the Action of Sunlight on the Sal s of Uranium," by Dr. H. C. Bolton, the substance of which has been published in the *American Journal of Science.* Mr. H. Wurtz then read a paper "On the Carbon Minerals," which he promised to introduce again at the next session, as want of time prevented the gentlemen present from entering into any discussion.

The Discovery of Rock Salt in Canada.—It is reported that extensive beds of rock salt have been discovered on the Canadian shore of Lake Huron. The discovery of rock salt in this portion of the North American Continent will not cause surprise, as the existence of extensive deposits in this region has long been indicated by the abundant flow of strong brine from the salt wells. Nine million bushels of salt were manufactured during a single season on the Onondaga salt reservation in New York State, and, notwithstanding the pumping of about four hundred and fifty million gallons of brine necessary to produce this quantity of salt, no change in the strength of the brine was noticed at the end of the summer.

The Manufacture of Zinc from the "dry bone" and "black Jack" of the Upper Mississippi lead region has become an important branch of industry. At La Salle, Ill., fifty tons of ore are smelted daily, three hundred men are employed, and one hundred tons of coal are consumed.

New Tin Deposits have been discovered in the coast range in Los Angelos County, California.

William B. Gravis, M.A., a graduate of Amherst College, and for some time past Peabody Instructor in Natural Science, at Phillips Academy, Andover, has been appointed Professor of Natural Sciences in Marietta College, and accepted the position. He is expected to enter upon his duties there early in the spring.

Prof Henry Morton, of Philadelphia, is to be the President of the Stevens Scientific Institute at Hoboken.

The Chemical Society of Berlin held a Hofmann festival on the evening of Jan. 8th, in honor of the founder of the Society, Professor A. W. Hofmann. Prof. Hofmann, who has enriched the science of chemistry by some of the most brilliant discoveries of the present century, was for many years in London, but has recently accepted a call to Berlin, where he has erected a very complete laboratory at a cost of four or five hundred thousand thalers.

The Faculty, Trustees, and Friends of the School of Mines of Columbia College have had a beautiful life-size medallion of President Barnard executed by Kuntze for the library of the school.

Scientific Lectures.—That science has become very popular in New York is shown by the number of scientific lectures and the large audiences that attend them.

Dec. 7.—Prof. Edward L. Youmans lectured on "*The Dynamics of Life.*" at Steinway Hall, under the auspices of the Society of Mechanics and Tradesmen.

Dec. 17.—President Andrew D. White, of Cornell University, lectured in the great hall of the Cooper Union, before the American Institute, on "*The Battlefields of Science.*"

Dec. 24 —Prof. E. S. Morse, of the Peabody Academy of Science, lectured at the Cooper Union, on "*How Animals Move,*" before the American Institute.

Dec. 31.—Prof. George F. Barker, of Yale College, lectured at the Cooper Union, before the American Institute, on "*The Correlation of Vital and Physical Forces.*"

Jan. 7.—Prof. R. Ogden Doremus lectured before the Young Men's Christian Association, in their new hall, on "*Gaseous Bodies and How they Become Solid.*" This is one of a series of lectures on the creation of the earth.

Jan. 7.—Prof. John W. Draper lectured before the American Institute, on "*Air and Respiration.*"

Jan. 8.—Prof. Ebell lectured at the Cooper Union on "*Animal Life.*" This is the first of the annual series of free lectures, given by the Trustees of the Cooper Union of Science and Art.

Brooklyn is not behindhand in supporting scientific lectures, Prof. George F. Barker delivered two lectures on "*Spectrum Analysis,*" to the fullest and best houses ever accorded to a public lecturer in that city.

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NOTES FROM THE LABORATORY OF A SUGAR REFINERY.

BY WILLIAM ARNOT, F.C.S.

I. Dr. Schiebler's Calcimeter.

The almost daily use, for some years, of Dr. Schiebler's expeditious instrument for the estimation of carbonic acid in carbonates, and the invariably consistent results obtained, have made it quite a favourite with the author of these notes. Believing the instrument to be far too little known, he would seek to call attention to its value, especially to those who have the charge of sugar refineries, where the frequent estimation of calcic carbonate in animal charcoal is a desideratum.

With a little practice, twelve or fourteen estimations may easily be made in an hour; and these, if upon the same finely-powdered sample, will, with ordinary care, be found to agree almost absolutely. The saving of time by this process over the most expeditious of the ordinary gravimetric methods (which alone are applicable to substances like bone-char) will be found to be very great. Starting in each case, with the sample in powder, the difference in time is such as easily to repay the first cost of the instrument by a few hours' work. As the instrument is sold with a normal weight and tables of calculated results, no time is lost in after calculations. The volume of carbonic acid, and the temperature indicated by the instrument, are referred to the tables, where the percentage quantity of carbonic acid or calcic carbonate is at once found. One great advantage of such an expeditious method as this is that there is no temptation to be satisfied with first results, as a few minutes suffice to repeat the process. A general description of the instrument and process, in English, will be found in the last edition of "Fresenius" (Quantitative Part); but a perusal of the original German instructions will be found profitable.

In most freshly-burnt bone-chars, traces of sulphides are to be found. These, of course, vitiate the results obtained by Dr. Schiebler's instrument to a trifling extent; but the author has not found, over a wide experience (unless on one occasion), more than 0·5 per cent of the evolved gases to be hydric sulphide; so that, for all practical purposes, that may be entirely overlooked.

II. The Action of Finely-Divided Carbon on Solutions of the Chromates in Hydrochloric Acid.

On the occasion of finding excess of sulphides in a sample of bone-char, referred to above, an effort was made to oxidise the sulphur simultaneously with the evolution of the carbonic acid in the decomposing jar, but only with indifferent success. In the course of the experiments, undertaken with that end in view, a solution of potassic bichromate in strong hydrochloric acid was used. On decanting this solution from the little gutta-percha tube, upon the powdered charcoal in the decomposing jar, *instant* and *rapid* disengagement of chlorine resulted. It is well known that chlorine is *slowly* evolved from the solution referred to in the cold, *more rapidly* when heat is applied, and *still more rapidly* on the addition of alcohol and some other organic substances.* Animal charcoal, or bone-black, which produced the *instantaneous* effect referred to, is a very complex agent. Its peculiar action as a decolouriser is well known. It was, therefore, a question whether this was an action analogous to decolouration, or if it was due to the action of some individual substance present in the char. The various constituents were tried, one by one, in every case, without producing the result, unless with the carbon, which, when as pure as attainable, produced the very same result as the original powdered char. The char, minus the carbon only, had no effect. It was, therefore, clear that it was the carbon which had brought about the instantaneous decomposition. This carbon exists in a very fine state of division. Its action, in this case, must be analogous to that of platinum, in mysteriously determining the decomposition of certain substances, as the carbon itself is in no way acted upon. Further experiments were made, to determine whether this action was similarly promoted by other forms of carbon. Many varieties, from both vegetable and mineral sources, were tried; but in no case was the decomposition of the chromate solution promoted to any appreciable extent by their presence. Charred blood was also tried, and with more success, though the decomposition was by no means so rapid as in the case of the bone-char.

III. Prejudicial Action of Sulphites and Sulphates in the Refining Process.

Besides the impurities natural to unrefined cane sugars, and which vary in quantity, and to some extent in quality also, according to the care bestowed in the manufacture and other local circumstances, there are not unfrequently present one or more injurious agents which have been introduced, not as adulterants, but to counteract some adverse natural circumstance or action. Among these agents bisulphite of calcium occupies a prominent position. In several cane-growing countries, the natives, or colonists, are dependent, in great measure, upon wind power for the performance of certain mechanical operations; pressing the juice from the cane is one of these. The canes being ripe and the wind fair, the planter proceeds to cut down his crop; but, before this is well accomplished, the wind falls; what is to be done? To allow the cut canes to lie in their natural condition until a favourable breeze springs up, may be to submit to a very serious loss of crystallisable sugar by fermentation. To counteract this destructive process, bisulphite of calcium, mixed with water, to the consistency of ordinary milk of lime, is sprinkled over the canes from time to time, until the elements supply the necessary motive power to allow the pressing to proceed. As the pressing goes on, the lime salt mingles with the juice, and is never afterwards entirely removed from the manufactured sugar. Much of the raw sugar which arrives in this country, to undergo the process of refining, thus contains notable quantities of sulphites and sulphates; these range in quantity from the merest trace to amounts which might seem to some incredible. In these circumstances it becomes important to ascertain the action of these salts in the refining process, and their consequent effect upon the value of sugars containing them. In the first place, they, of course, in common with all other impurities, reduce the percentage quantity of saccharine matter in the sample; and as it often enough occurs that the *best looking* samples contain the impuri-

* *Gmelin*, Cav. Soc. Trans., vol. iv. p. 120.

[English Edition, Vol. XXI., No. 528, pages 1, 2.]

ties referred to in greatest quantity, it is always advisable to estimate the total impurities previous to purchase. The sugars being blown-up and mechanically filtered, are next submitted to the purifying and decolourising action of animal charcoal; in this process a large proportion of the sulphites and sulphates are removed and retained within the pores of the char. The washing, to which the char is afterwards subjected, removes a portion of these salts along with other impurities, but they are never entirely washed out. The re-burning succeeds the washing, and in this process the sulphates, or a portion of them, depending upon the temperature at which the re-burning is conducted and other minor circumstances, are decomposed at the expense of the carbon—carbonic anhydride being evolved and calcium sulphide formed. The char being re-burned and cooled is ready for its work of decolouration again; the sugar liquors—acid almost to a certainty—are run upon it, and as they pass through, decompose the calcium sulphide, with formation of hydric sulphide, which the liquors absorb. There are thus two prejudicial effects produced: first, the removal of a portion of the most valuable agent in the char—the carbon—and next the formation of an agent in the sugar solution, which is most potent in promoting fermentation, and consequent destruction of saccharine matter. The quantity of carbon removed and hydric sulphide produced by one complete circle of the refining process is comparatively trifling, but when it is remembered that the same char is often re-burned and used twice a week, the ultimate extent of the injury can be imagined. From extended personal observation, the author of these notes is satisfied that from 10 to 20 per cent of the decolourative power of animal charcoal may be destroyed in the course of twelve months by a continued use of sugars containing the agents referred to.

A little consideration will show, what numerous experiments have proved, that char *ready for re-burning* seldom or never contains sulphides, while re-burned char always contains more or less; *traces* of sulphur compounds being, as a rule, present in all unrefined sugars.

Long experience and numerous experiments have enabled the author to decide upon deductions to be made, from the marketable value of sugars, in proportion to the quantity of sulphates, &c., they contain. The mode of testing is exceedingly simple, but as the conclusions come to are quite arbitrary, so far as monetary figures are concerned, he would not advise the unexperienced to proceed upon his system, but would suggest to those interested in the problem a careful experimental investigation of the whole subject.

IV. The Chemical Impurities of "Low" Beet Sugars.

As a rule, the finest products of the beet are manufactured directly into loaves in the various beet growing countries; the second, or perhaps more frequently, the third crop of crystals being exported.

British refiners are thus called upon to deal with sugars containing large proportions of chemical impurities, some of them very injurious to the sugar itself, while others act most prejudicially on the charcoal used in the refining process. Amongst these agents, sulphates usually hold a prominent place; it is needless to say that their action is just as injurious in the product of the beet as in that of the cane. Alkaline chlorides also abound, and their action is at least as injurious as that of the sulphates. Any one who has had the opportunity of observing beet sugar liquor, and cane sugar liquor, of the same original colour, passed through separate cisterns of the same charcoal, must have been struck with the very great difference in the effect produced; the cane liquor bright and colourless, the beet *possibly* bright but decidedly yellow; and this difference is rather increased than lessened by the after process of boiling. The share which the alkaline salts have in reducing the colour value of the refined product is unquestionable, and their injurious action does not end there; they tend throughout the whole refining process to destroy crystallisable sugar, while their action on the charcoal, unless when very copious washing is practised, is very objectionable. The salts referred to, being fusible, the risk of coating the char in the re-burning process is considerable. Several otherwise good chars, which have been sadly injured in this way, have come under the author's observation. The practical point to be observed is this, that whereas even the very lowest "beets" commend themselves to the eye, in virtue of the size, strength, and abundance of the grains or crystals, they are often so charged with potent impurities, as to be entirely inadmissible as subjects for the British refiner to operate upon. The evil effects of the repeated use of such low-class beets soon manifest themselves over the whole refining establishment—not least on the sale-room counter.

The foregoing has, of course, little or no reference to the beautiful first products of the beet, occasionally imported, though even these are tainted, to a greater or less extent, with some of the characteristics of the low beets.

In the circumstances here noted, it must be manifest to every refiner, that to purchase beet sugars, or indeed any sugar, as will be evident from a perusal of the preceding (III.) note, by the rule-of-thumb system, so generally prevalent, is, to say the least of it, very risky.

Nothing but rigorous chemical examination can point out the true commercial value of unrefined sugars. The eye can detect many useful indications of quality, but these ought always to be supplemented by an investigation of the qualities which do not appear on the surface, and which chemical analysis alone can reveal.

Dubrunfaut, who, along with other continental chemists, has made the action of the impurities of beet upon the crystallisable sugar a special study, has fixed upon a coefficient by which to arrive at the quantity of *extractable* sugar contained in any sample submitted to analysis. The removal of these objectionable salts has also engaged the attention of several eminent continental chemists, and from the results obtained, it is manifest that other methods of dealing with beet sugars must be adopted from that followed in the refining of the produce of the cane. We in Britain seem to have fallen asleep upon this subject. The process of sugar refining is eminently a chemical one, and at every stage there is room for investigation and improvement.

V. Precautions to be Observed in Estimating the Relative Decolourative Power of Chars.

Simple as the process of testing the relative decolourative power of char samples may appear, very perplexing results are not unfrequently obtained. The object to be aimed at is to make the circumstances which obtain, as nearly as possible, the same on the small scale as on the large, and it is because many little precautionary measures which tend towards the attainment of that equality are usually omitted in the laboratory

that such conflicting and apparently inexplicable results are recorded. After many modifications of the process, the author is satisfied, from the results of experiments extending over a considerable period, that if the following points are carefully attended to, the results may be relied upon.

1. It must be decided what the results are to express; whether the relative decolourative power of *equal bulks* or *equal weights* of the chars, *irrespective of size and proportion of grain*, of the chars *uniformly freed from dust*, say by a fifty-mesh sieve, or of *equal weights* of *equal grains*.

2. According as either of these alternatives is decided upon, the various samples must be thoroughly and intimately mixed, and, if necessary, brought to an uniform dryness and temperature. It is always safest to have them thoroughly dry, and at the temperature of the surrounding air.

3. The various samples are next to be filled into glass tubes (tin may be used, but they preclude observations of a very important kind) provided with perforated false bottoms, covered with layers of cloth, and with taps capable of being accurately regulated. The tubes ought to be about 2 inches wide and 2 feet long, as nearly of the same diameter as possible. The best method of filling them is by passing the char through a funnel, keeping the spout of the funnel moving constantly in a circular direction, so as to have the large and small grains equally diffused throughout. To allow the char to run down either at one side, or, to a less degree, in the middle, is to cause to a certainty a separation of the larger grains from the smaller, and thus to create channels through which the liquor has too easy access.

4. See that no tube is touched or shaken more than the others, after the char has been filled in.

5. Sufficient brown sugar liquor, of, say, 24° B, must be prepared, either by diluting raw filtered liquor from the sugar-house to that gravity, or by dissolving as much of an average quality of raw material as will make sufficient liquor for the whole experiment. In the case of preparing it on the small scale, albumen or blood must be liberally used, and the liquor passed through paper filters—coarse French paper answers best. The albumen should not be added till all the sugar has been dissolved, and the temperature at, say, 160° F. An equal quantity of the prepared liquor, as nearly 180° F. as possible, must now be poured uniformly upon the char in each tube.

The rapidity with which the liquor passes through the chars in each case may be noted. Care must be taken to have the top of the char always covered with liquor, and the taps below open. As soon as the liquor begins to drop at the taps they are closed.

6. The tubes being fully charged with liquor (there should be as much left on the top of the char as will serve to force out the liquor in the char), they are put into a cistern of water at 140° F., the water in which will rise to about 1 inch from the mouths of the tubes, the time is noted, and the cisterns, which ought to be felted, covered.

7. At the end of not less than one hour (longer than one hour is sometimes advantageous, particularly if the raw liquor was very brown), the tubes are withdrawn, placed in their stand, and about 2 ounces of liquor run off each; this may be rejected, as the portion between the false bottom and tap is often turbid, and in addition has not been in contact with the char for a sufficient length of time. The remainder of the liquor, *i. e.*, so much as has actually been in contact with the char, may now be run off in three successive quantities for comparison. The results may be compared to any set of standard colours, and recorded accordingly.

8. If these results are not sufficiently instructive, a further quantity of raw liquor may be run on each tube, and the whole transferred as before to the water-bath, which, if felted, will still be hot enough. The second quantity of liquor will be run off with the same precautions as the first, and the results will show the *relative persistency* of the chars under trial.

If the taps are large the liquor will be likely to run off too rapidly, and, in that case, they had better be partially and uniformly closed.

If it is found that the liquor runs through one sample particularly slow, and through another particularly fast, it is quite admissible to assist the one by suction, and to check the other by closing the taps, but this should not be done unless in extreme cases, and the fact of having so assisted or retarded the process should always be noted.

It is scarcely necessary to mention the several points wherein the foregoing differs from the course usually pursued in testing chars, and yet it may be useful briefly to indicate some of these.

Too little care is usually bestowed upon the selection and preparation of the samples. The tubes used are, as a rule, too small; the char cannot be run so uniformly into small tubes as large ones. The samples once charged with liquor are not usually kept warm; it is essential that they should. Some chars act powerfully at low temperatures, while others require a considerable amount of heat to bring out their maximum decolourative power; care must, however, be taken that the temperature employed does not exceed that attained on the large scale in the refining process. The fact just noted does not seem to have been much investigated; it is worthy of careful consideration, not only on the part of experimentalists, but also by the practical refiner. One sample of char, known to be of very inferior decolourative power on the working scale, persistently gave results, by the usual method of testing in the laboratory, equal to the very finest chars obtainable, but when kept at an elevated temperature along with the finer samples, in the manner indicated above, its inferiority was at once manifest. The facts in this case were that the inferior char readily yielded *all* its decolourative power at the low temperature, while the finer samples required the influence of heat to call their whole power into action.

VI. The Constituents of Char, Important and Unimportant.

In the absence of a knowledge of the refining process, and the circumstances attendant on the use and revivification of animal charcoal, much time may be unprofitably spent over an analysis of that agent. While it is always desirable to have analyses carefully and accurately executed, the analyst should be able to discriminate between the essential and non-essential elements or compounds in the substance before him, and, while he aims at general accuracy, more than usual care should be bestowed upon substances the presence or absence of which mark the value of the agent under examination.

The points of greatest importance in an analysis of animal charcoal are the carbon, the carbonates, and the iron; the decolouriser, the neutraliser, and the destroyer. Under certain circumstances the sulphates

may also be included in the list, and in the case of new unused char the alkaline salts should be carefully estimated. These essential points carefully ascertained, no modification of them should be thought of, whatever the phosphates may come out. If the analysis should come to 105, ten to one but the phosphates are to blame and not the carbon and carbonates. The phosphates are comparatively unimportant, and when it is remembered how various are the methods employed, and how faulty some of them are,* errors under that head need not be greatly wondered at. There is no excuse whatever for error in the carbon, the process is simplicity itself; the carbonates can be quickly and accurately estimated by the calcimeter (Note I.), while the iron, after some little practice, can be safely got at by Penny's process, using a very dilute solution of bichromate. The iron is always in the state of protoxide, faint traces of peroxide excepted, owing to the reducing action of the carbon in the re-burning. Of course, these remarks are intended to apply exclusively to commercial samples for use in the refinery. When char is to be sold for the manufacture of manure the circumstances are altered, and the phosphates become the essential element in the analysis.

VII. M. Gaston Tissandier's Method of Analysing Animal Black.

When the author of these notes penned that immediately preceding this, he little thought that it was at all necessary to go into the details of the process of analysis, but contented himself by simply throwing out a hint or two upon the subject; the simultaneous appearance of M. G. Tissandier's notes upon animal black with his own has, however, shown him his mistake. The methods recommended by that gentleman are so faulty as to demand some special remark.

1. *The Carbon.*—M. G. Tissandier arrives at the proportion of this most important agent by a method which cannot be relied upon. The writer at one time thought that he had made a great time-saving discovery, when the idea of doing as M. G. Tissandier recommends struck him, but he soon found out his mistake: the difference between the "ash" and the original weight *does not* give the carbon and moisture. To whatever cause it may be due, the results obtained by this process always differ from those obtained by the more trustworthy method hereafter to be described. Two objections to M. G. Tissandier's process may be pointed out—There is always iron present in animal black, and, as indicated in the preceding note, it always exists as protoxide; this is, of course, peroxidised by M. G. Tissandier's process. The carbonates are liable to decomposition, and though caution, during the process of calcination, is recommended, the manipulator has no guarantee that he has not decomposed a portion of them; and to moisten with ammonium carbonate, as recommended by Dr. Wallace, is not at all safe. The analysis should always be made upon the dried sample—the moisture may, of course, be estimated in the usual way, in a portion (several hundred grains) of the original *unground* sample; but, with working chars, unless the sample is for sale, the moisture may be left out altogether. It may be necessary to state, as a reason for estimating the moisture in the original char in preference to the pulverised, that in the process of grinding, which occupies some time, the char, if comparatively dry, is liable to absorb moisture from the atmosphere. 50 grs. of the sample, in impalpable powder (which *should not* be sifted, but the whole reduced uniformly to the necessary fineness, the hard gritty grains which so persistently resist the action of the mortar and pestle sometimes, have usually a different composition from the softer portions, and ought not to be rejected, as M. G. Tissandier recommends), are boiled in dilute hydric chloride; twenty minutes are usually necessary to accomplish this satisfactorily. The insoluble is thrown upon a weighed filter, and very thoroughly washed; the filter, after drying, is weighed—the difference being carbon and sand. The drying and weighing must be very carefully attended to; after the first weighing, the filter should be returned to the drying oven, and after a time weighed again, and so on until the results are constant. The filter is then ignited, the residue being sand and clay; the weight of this, deducted from the previous result, will, of course, give the carbon, and that accurately. The carbon being a most, if not the most, important element in the char, its accurate determination must be made a point in the analysis.

2. *The Silica* by M. G. Tissandier's process will be found much too high; "water acidulated with chlorhydric acid," "slightly heated," will scarcely have the desired effect upon ignited "ash." The twenty minutes' boiling with moderately strong acid, referred to above, will be no more than competent to do the work indicated, but from the preceding remarks it will be seen that the sand, &c., can be got at otherwise.

3. *The Phosphates*—It seems passing strange that the system of precipitation by ammonia should again require to be publicly protested against. The results by this process are worth nothing; and how, otherwise than by accident, an analysis can be got to come to 100 when it has been employed the writer cannot guess. Perhaps if M. G. Tissandier had been asked to reconcile the phosphate results of different analysts (as the writer has been), he would long ere this have consigned the process to oblivion. Better leave the phosphates alone altogether than precipitate them by ammonia; the analysis will more likely be correct. Precipitation as ammonio-magnesian phosphate will, with care, give reasonably-accurate results.

4. *The Carbonates* must not depend upon the lime left over in the solution after the separation of the phosphates: many errors creep in here. The total lime should be estimated by precipitating with oxalate of ammonia, as a check upon the other results; but the carbonic acid itself must be the guide to the amount of carbonates. One process for carbonic acid has already been referred to with favour. In the absence of Dr. Schiebler's apparatus, however, some of the usual gravimetric methods admitting of the use of hydric chloride may be employed.

5. M. G. Tissandier makes no mention of iron in his analysis. He may be dealing all alone with new, unused char, in which the iron is usually very trifling; but he does not say so. The iron is an essential point in the analysis of used chars, and is not to be passed lightly over even in new, unused chars. As already indicated, its estimation may be accurately made by Penny's process. The strength of the bichromate solution best adapted for the delicate operation is 2·75 grs. of the pure and dry salt to 1000 grs. of water; in which case the alkalimetric measures consumed will be divided by 16 to give percentage of metallic iron—*i.e.*, supposing 100 grs. of the char to have been used. The process must be conducted neatly and rapidly, as the

* Chemical News, vol. xi., p. 49, *Eng. Ed.*

solution is liable to absorb oxygen from the atmosphere.

M. G. Tissandier concludes this part of his paper by appending the results of the analysis of three samples of char. The writer has seen and executed several hundred analyses of this agent, and never, in all his experience, has he met with more extraordinary results than those given by M. G. Tissandier, as illustrative of the composition of this substance (?). Are these the analyses of new chars, or old? Have they been used in the "beet" manufacture, or in connection with some special process? Where is the iron, and the sulphates? For what object are the results published? Without some information upon these points, they can only mislead the reader.

M. G. Tissandier's method of estimating the decolourative power of chars is very pretty, but of no practical value. The results will express *the relative power of pulverised animal-black to decolourise caramel;* but that is not what the sugar refiner requires. For sugar-refining purposes, nothing but sugar-refining methods of testing decolourative powers will do. The author has tried many devices, both with grain and pulverised char, with log-wood decoction, caramel, &c.; but the results in no case give the true value of the char to the refiner. The directions given in Note V. have been followed, with the most satisfactory results, for three years. During that time, several other *simpler* systems have been tried; but all have had to give way to the *more tedious, but accurate,* system described.

THE MODE OF TESTING MINERAL OILS USED FOR LAMPS.

BY BENJAMIN H. PAUL, PH.D.

The degree of inflammability of the mineral oil now used for lamps is a character which the chemist is sometimes called upon to determine; and since recent enquiries appear to indicate that there is considerable difference of opinion as to the mode in which mineral oil should be tested for the purpose of determining that character, I have thought that this subject, though not one of any scientific interest, would be worth bringing under the notice of the readers of the Chemical News, especially since the degree of inflammability of mineral oil is now attracting considerable attention in reference to the question of danger attending the use of such oil in lamps.

All kinds of mineral oil, whether derived from coal, or bituminous shale, or from petroleum, are, by their nature, more inflammable than the fat oils, such as sperm oil and colza oil, formerly used for lamps, that is to say, they take fire more readily and at a lower temperature than the latter; they also differ from those oils in being partially volatile at a temperature which has no similar effect upon the fat oils. Since the vapour thus given off is inflammable, and, when mixed with air in due proportion, capable of exploding, it is evident that the use of any kind of hydro-carbon oil requires, for both the reasons just mentioned, a greater degree of care than is necessary in the use of fat oils.

In considering the question of danger to be apprehended from the use of mineral oil in lamps, the conditions under which it is used in a general way must be taken into account; and so far as the inflammability of the oil is concerned, the point to ascertain is not merely what oil may be used without any necessary danger, but what kind of oil will answer the purpose for which it is required as an illuminating material without, at the same time, requiring any greater degree of caution in its use than can fairly be expected under the circumstances. Even the more volatile portions of petroleum and paraffin oil, constituting what is generally termed "spirit," or naphtha, benzoline, ligroine, &c., may be burnt without any necessary danger in some of the ordinary paraffin lamps, which are constructed in such a manner that there is no free communication between the flame and the oil reservoir. But this material, which begins to boil below 100° F., and distils over completely below 300° F., while it is readily volatilised at the ordinary atmospheric temperature by contact with air, is much too volatile for general use in that way, except in the special form of lamp known as the "sponge lamp;" and, for that reason, it can scarcely be regarded as a suitable material for burning in what is termed the paraffin-oil lamp. The fact that it can be used in this way serves merely to show that any danger attending the use of mineral oil in lamps is less referable to its volatility and greater inflammability, as compared with fat oils, than it is to carelessness, or misuse, and the neglect of those precautions which the nature of this material renders indispensable. But though the possibility of improper usage cannot reasonably be regarded as justifying any considerable restrictions in the application of a material so useful as mineral oil, still some allowance requires to be made for it; and since, in this respect, the degree of inflammability is the character of the greatest importance, it is customary, in the operation of refining, to separate and exclude from the oil to be used for ordinary lamps, a certain amount of the more volatile hydrocarbons contained in the crude petroleum or paraffin oil. The extent to which this is done is not in all cases the same, and there is some difference of opinion as to what should be the minimum degree of inflammability of the oil, or the minimum temperature at which it should be capable of giving off inflammable vapour, in order to ensure for it such a degree of safety as would be consistent with the general circumstances under which it is used in lamps and kept as a commodity in shops. By some, it is considered that when a flame is brought into actual contact with the oil, heated in an open capsule, it ought not to take fire, so as to continue burning, until the temperature reaches 130° F. Others, again, consider that, if it does not take fire at a temperature below 100° F., it is of a character fit to meet all requirements.

Hitherto, far less attention has been paid to the degree of inflammability of mineral oil than to the absence of smell and colour. It has also been customary in different countries to use oil differing widely in regard to the temperature at which it would take fire. Some years ago, the oil generally consumed in this country had a very high firing point, and it was customary to test it by observing how long it would bear contact with the flame of a match without taking fire, or more accurately by observing the temperature at which it took fire and continued to burn. This temperature was generally from 120° to 130° F., and sometimes it was as high as 150° F. The oils manufactured about eight years ago, from Rangoon petroleum, and from coal or bituminous shale, were of this kind. On the Continent, oil inflammable at a much lower temperature has generally been preferred.

After the introduction of American petroleum, there was a marked difference in the character of the imported lamp oil manufactured from this material, so far as re-

gards the degree of inflammability, and it would often take fire at a temperature little above 100° F. During the last three years, the firing point of this oil has been still further reduced, and probably the greater part of the lamp oil imported from America and made from petroleum, which has been consumed during that period has had a firing point below 100° F., sometimes considerably lower.

In addition to the differences, both of opinion and practice, in regard to the degree of inflammability of mineral lamp oil, there are also similar differences as to the mode of determining this character, and as to what is to be regarded as the firing point.

This oil being in all cases a mixture of several hydrocarbons belonging to the paraffin series chiefly, and varying in their boiling points from about 200° to upwards of 700° F., the temperature at which it begins to give off vapour will depend upon the boiling points of the more volatile hydrocarbons, and upon the amount of them contained in the oil. Consequently, when the oil is gradually heated in contact with air, and a flame is brought near the surface from time to time, there is always a little momentary flash, produced by the vapour taking fire; and this happens some time before the oil attains the temperature at which it takes fire itself, and continues to burn. The difference between the temperature at which the temporary flash takes place, and that at which the oil takes fire, will amount to from 10 to 20 degrees Fahrenheit.

Upon the assumption that an explosive mixture of oil vapour and air may be formed within the reservoir of a lamp, it has been urged that the temperature of the oil when this temporary flash takes place should be considered as the firing point of the oil.

The quantity of vapour given off by mineral oil at the temperature when the first temporary flash takes place, is generally very small, even when the oil itself takes fire at 100° F.; and as the oil in the glass reservoir of a paraffin lamp, while it is burning, seldom acquires a temperature more than about ten degrees above that of the surrounding atmosphere, there would not be much probability of any such quantity of vapour being produced within the reservoir as could give rise to explosion by contact with flame. In regard to this point, however, the construction of the lamp is of considerable importance. In some lamps the pin by which the height of the wick is adjusted is so arranged that there is free communication between the flame of the lamp and the oil reservoir, and between the two there is a small metal chamber, with a hole at the side, through which the pin passes. This chamber, in common with the other brass fitting of the lamp, being heated to a temperature much above 100° F., will of course become filled with vapour given off from the oil as it passes up through the wick; and that vapour, by mixing with air, may form an explosive mixture in the immediate neighbourhood of the flame. In other lamps the pin is fitted in such a way that there cannot be any accumulation of oil vapour near the flame, and there is not any communication between the flame and the reservoir, except through the tube in which the wick is placed. The latter form of lamp is in this respect much preferable to the other, and it is the only kind of lamp in which a very volatile oil can be burnt. But the fact of most importance in regard to the determination of the inflammability of mineral by the "flashing point" is that the result obtained with a given sample of oil in this way may vary several degrees, according to the mode in which the test is applied. If the surface of the oil is freely exposed to the air, in an open vessel, such as a shallow capsule, the firing point of the vapour may be found to be some degrees higher than when the test is applied in a small wide-mouthed bottle, or in the reservoir of a paraffin lamp, half-filled with the oil.

The difference before referred to between the temperature at which, in testing oil to ascertain the firing point, the temporary flash takes place, and that at which the oil itself takes fire and continues to burn, also depends very much upon the mode in which the experiment is made. With a shallow, open basin, the difference is much less than it is when a wide-mouthed bottle or a small lamp-reservoir is used. The more freely the surface of the oil is exposed to the atmosphere, the lower will be the temperature at which it takes fire; while, on the contrary, the less freely it is exposed, the lower will be the temperature at which the vapour given off takes fire. Consequently, in fixing a point of temperature as the minimum at which either the oil itself or the vapour it gives off should take fire by contact with flame, it is necessary that the conditions under which the experiment is to be made should be precisely defined, and that the testing of oils should always be conducted in the same manner, so as to obtain uniform and corresponding results. It is, of course, desirable, also, that these conditions should assimilate as much as possible to those obtaining in a paraffin-oil lamp when it is burning, since any danger that might arise from the inflammability of the oil would exist chiefly in the ordinary use of this material in lamps.

It is singular, however, that the Act passed in 1868, to amend the Petroleum Act of 1862, prescribes a mode of testing mineral oil under conditions that are the direct opposite of those prevailing in the use of the oil. While a mineral oil lamp is in use, the oil is heated in a closed vessel partly filled with air, which thus becomes charged with oil vapour, proportionately to the volatility of the oil, or part of it, and to the temperature the oil is raised to. Any oil vapour given off is confined; and, if the oil be sufficiently volatile or sufficiently heated, such formation of oil vapour may result in the production of an explosive mixture within the oil-reservoir of a lamp.

On the contrary, in testing mineral oil according to the directions given in the Schedule appended to the Act of 1868, the oil is heated in an open vessel, with the surface freely exposed to the atmosphere. Under these conditions, any oil vapour formed is liable to diffuse away into the surrounding air, and become thus so much diluted as to lose its inflammable character. Consequently, the temperature at which the momentary flash takes place with any given sample of oil when a flame is brought near its surface, will be, for that reason, higher than when the escape and dilution of the oil vapour is prevented—as in a paraffin lamp, or by making the test in a partially closed vessel.

A still more serious interference with the results of the test would be experienced if the operation were conducted in a place exposed to draughts; and probably much of the discrepancy in the results of oil-tests has arisen in this way.

But there is yet another source of discrepancy in the results of tests made in accordance with the directions of the Petroleum Act, and one which is of far more importance, because no notice is taken of it in those directions, and, consequently, its influence may be greater or less according to accident or to the practice of the operator. This source of error lies in the rate at which

the oil is heated, or the time occupied in making a test. All that the Act directs in this respect is that "a small flame shall be applied to the bottom of the outer vessel," which serves as a water-bath, and that this vessel "shall be filled with cold, or nearly cold, water." Both these directions are extremely vague. But, leaving out of consideration any difference that might arise from using "cold" water at 40° F., or "nearly cold water" at 70° F., the rate of heating the oil from either temperature up to 100° F. has such an influence on the result obtained that there may be a difference of quite 5 in the flashing point of a given sample of oil accordingly as the heating is made to occupy a longer or shorter time; and this will be the result, even though a "small flame" be used in both cases. Some experiments I have recently made show that there is a possibility of even greater variation in the result obtained as the "flashing point" of one and the same sample of oil.

Such a defect as this in the prescribed mode of testing mineral oil leaves the practice of this test entirely subject to the option or fancy of the operator; and it is alone sufficient to render the application of the test totally useless for the purpose of determining the character of mineral oil in regard to inflammability, and worse than useless for all the purposes of the Petroleum Act, besides rendering this Act and its application a possible source of serious inconvenience to those engaged in the mineral oil. On these grounds alone, therefore, there seems to be ample need for a revision of the law, and for the adoption of a more suitable test.

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ON CHEMICAL EQUILIBRIUM.

Influence of Pressure on the Reaction between Carbon and Hydrogen.

BY M. BERTHELOT.

The play of conflicting chemical reactions, and the equilibrium established between them, are simplest, theoretically, when such reactions are developed in homogeneous systems, entirely gaseous, or even entirely liquid, and capable of remaining homogeneous during the whole duration of the experiment.

Under these conditions, all the reacting particles remain in complete and unceasing contact, no secondary complication occurring to withdraw one of them from the field of chemical action. Not so in the case of reactions which take place between a gas, or liquid, and a solid; under these circumstances, reaction occurs only at the points of contact, which undergo the influence of numerous physical conditions, accessory and foreign to true chemical action, which they tend to complicate.

Meanwhile, the principal masses, separated from each other by the gaseous state of the one, opposed to the solubility of the other, remain neutral and inactive.

The homogeneous system is, therefore, in my opinion, the best adapted for the theoretical study of affinities—that is, the study of those forces which determine chemical combinations and decompositions.

From this point, my researches commenced upon the study of affinities, examined in ethereal reactions, which present a type of slow progressive action and of action limited by inverse reaction.

Ethereal reactions may be examined by an entirely gaseous system, or by one wholly liquid and permanently homogeneous. Their characteristic equilibrium varies continually with the relative proportions of reacting bodies, contrary to what occurs in reactions of acids on bases. It also varies continually in gaseous systems, according to the pressure—that is, according to the condensation of matter, but it is independent of temperature between the limits of zero and 280°.

The fundamental condition of homogeneity is, perhaps, fulfilled by reactions effected on the gaseous system under lively combustion, such as were studied with such advantage by M. Bunsen. Here the reactions are abrupt, and occur almost instantaneously: the equilibrium which generally arises between contrary actions no longer obeys the laws of continuity, but varies after the manner of chemical equivalents. When the proportions of reacting bodies change progressively—as, for instance, in systems formed of hydrogen, oxide of carbon, and oxygen, on the contrary, the relative proportions of products formed vary by abrupt leaps.

The relation between the entire volume of a mixture of combustible gas and that of the portion which will produce, at a given temperature, a new composition, also varies by abrupt jumps, when the temperature is gradually made to vary by introducing into the mixture an inert gas. There will then exist several intervals o temperature, more or less great, between which the limit of the reaction is independent of changes of temperature. To establish a complete parallel between ethereal reactions and those of the gaseous systems, the influence of pressure on the latter must be ascertained.

Between acetylene, hydrogen, and carbon reduced to vapour by the electric arc, or spark, such an equilibrium is established that a mixture of acetylene and hydrogen, made in suitable proportions, remains unaltered by the spark. If, on the contrary, acetylene predominates, it decomposes until the above-mentioned proportions are reproduced. These facts were established in a previous communication; since then, I have submitted a mixture of acetylene and hydrogen to the action of the spark under different pressures. This is my method of operation:—

The gases were contained in large eprouvettes, into which were passed gas tubes, bent round and traversed by thick platinum wire. The spark produced by a strong induction coil passed direct between the platinum wires, without breaking upon the glass or any other cold body capable of suddenly condensing the carbon vapour. The pressure was measured directly by the height of a column of mercury, and the mixture was analysed every hour, until the composition remained invariable during three consecutive tests. In the experiments made under very feeble pressure, it was necessary to repeatedly cleanse the eprouvettes containing the gaseous mixture, and, even then, to reject the first trials, because the formation of a small quantity of oxide of carbon proved the introduction of small quantities of air, or of moisture contained with the mercury. This oxide of carbon disappeared after the second or third trial, on care being taken to preserve from contact with the air the interior of the eprouvette and the tubes which conducted into it the platinum wire. The following results were obtained:—

Pressure.	Limit of Proportion of Acetylene in 100 volumes.
m.	
3·46	11·9
0·76	12·0 to 12·5 (in several trials.)
0·42	11·9
0·41	12·0

0·31	6·5
0·23	3·5
0·18	3·1
0·10	3·1

The pressure was not reduced further, because the volume of gas under treatment would have been too small for correct analysis.

These numbers prove that the equilibrium between the carbon, hydrogen, and acetylene remained fixed at the same limit (12·0) for pressures which varied from 0·41 m. to 3·46 m., that is to say, as 1 is to 8½.

The increase of pressure has no effect but to augment extremely the resistance to the passage of the spark, and also its brilliancy. According to my experience, this increase of brilliancy does not correspond with any change in the composition of the gas traversed by the spark.

Even the rapidity of decomposition, which causes the disappearance of the excess of acetylene under treatment, does not appear to vary much with pressure, as far as it was possible to judge under the circumstances. Below 0·41 m.—that is, at 0·31 m.—the limit is suddenly brought down to 6·5—viz., half the preceding one. At 0·23 m., the limit is suddenly reduced to the quarter of it, and remains the same, at least to 0·10 m.

Thus, while the pressure varies continually, the equilibrium between the acetylene, carbon, and hydrogen changes, by sudden leaps, in ratios which are multiples of each other.—*Comptes Rendus*, vol. lxviii., p. 810.

ON THE

MICROSCOPICAL EXAMINATION OF MILK UNDER CERTAIN CONDITIONS.*

BY J. B. DANCER, F.R.A.S.

In August and September last an account appeared in one of the newspapers (and also in other periodicals), which had been copied from the *Journal des Connaissances Médicales*, of some microscopical observations made by M. V. Essling, on Milk, in which the author stated that "if the surface of fresh cream be examined under the lens, one perceives, amid myriads of milky and fatty globules, a number of either round or oblong corpuscles, sometimes accompanied with finely dotted matter, being neither more nor less than germinative masses of vibrios—just what is seen in most substances in a state of putrefaction. In summer these corpuscles make their appearance within 15 or 24 hours after milking; in winter they will be perceptible after the lapse of two or three days. If the observation be continued until the moment of coagulation, we see these corpuscles increase in number, bud, form ramified chains, and at length be transformed into regular mushrooms or filaments composed of cells placed end to end in simple series, and supporting at their extremities a spherical knob filled with granulous matter. M. V. Essling thinks that they may be classified among the Ascophora. But the important point is, that the first appearance of these spores occurs *before the milk gets sour*, and as this substance is almost the exclusive aliment of children, there is reason to suppose that many of the gastric affections to which they are subject are owing to this state of the milk. To prevent these evil consequences, M. V. Essling recommends the milk to be drunk as soon as possible after extraction, and, at all events, to keep it closely bottled during the interval so as to keep out the smallest particle of air. Moreover, the temperature should be kept as nearly as possible the same as that which the milk had in the teats."

Having for many years been familiar with the microscopical appearance presented by milk and cream, and not having seen the changes as described by M. V. Essling, I was desirous of satisfying myself on this point, more especially as it affected a very important article of food. The composition of ordinary milk, as stated by Fownes, is as follows:—

Water	873·00
Butter	30·00
Casein	48·20
Milk sugar	43·90
Phosphate of lime	2·31
Phosphate of magnesia	0·42
Phosphate of iron	0·07
Chloride of potassium	1·44
Chloride of sodium	0·24
Soda in combination with casein	0·42
	1000·00

Composition of casein in 100 parts:—

Carbon	53·83
Hydrogen	7·15
Nitrogen	15·64
Oxygen, Sulphur	23·37
	100·00

Composition of albumen in 100 parts:—

Carbon	53·5
Hydrogen	7·0
Nitrogen	15·5
Oxygen	22·0
Phosphorus	0·4
Sulphur	1·6
	100·00

Casein and animal albumen are remarkably similar in composition; casein differs in not being coagulated by heat, and is precipitated by acetic acid. Certain animal substances cause its coagulation, such as the dried stomach of the calf, known as rennet, used in the manufacture of cheese.

When a thin film of milk is examined with the microscope, it is found to be a transparent fluid, in which are floating numerous transparent globules of fat; these are surrounded by a thin pellicle, and when this pellicle is broken mechanically, as by churning, the fat is liberated and forms butter. The fluid part consists of casein, saccharine matter, and salts in solution. The proportion of these organic principles varies in different animals, and also in the same animal when fed under different conditions. Human milk usually contains a larger proportion of sugar than cow milk, and is coagulated with greater difficulty. It is well known that the secretion and quality of milk is influenced by the mental emotions. Milk as obtained in towns is frequently adulterated, and as foreign matter would alter its microscopical characteristics, it was necessary to procure pure milk. One of our members, Mr. Kipping, kindly supplied me with a bottle of fresh-drawn milk. The cow had calved about three

* Read before the Manchester Literary and Philosophical Society, November 30th, 1869.

months previously, and had been fed on grass, bran, and bean-flour. This milk was examined soon after I received it, and was found to be very rich in oleaginous globules, forming a plentiful supply of cream. There was no appearance of dotted matter or any fungoid growth when examined by powers varying from 200 to 1500. The smallest oil globules exhibited (as usual) great molecular activity. A bottle was filled with some of this milk, and securely corked; other portions of the milk were placed in open cups; one cup was kept in a cabinet which was closed during the day, the milk of the second cup was placed in a closet, the atmosphere of which I knew to be favourable to the growth of fungi, the Mucor Mucedo being the most abundant and of the same family as that mentioned as having been found in cream by M. V. Essling. The milk in the bottle and that in the cups was examined daily, precautions being taken to close the bottle speedily after a portion was removed. On the third day, the milk in the open cups was sour to the smell, but no change appeared visible under the microscope; the upper portion of the milk in the bottle had become very rich in oil globules by the formation of cream. On the fourth day the casein had coagulated in the milk in the open cups, and the flaky precipitate was visible under the microscope; the pellicle surrounding the oil globules now appeared to be very easily ruptured, and with the slightest pressure some of the globules could be joined together—sometimes a number of globules which had been ranged in line by a current would coalesce by a slight movement of the fluid, and form an elongated mass. Fifth day, no appreciable alteration. Sixth day, the milk which had been placed in the closet had patches of mould visible on its surface; a microscopical examination of this mould showed it to be the Mucor Mucedo, such as I had frequently found on fruit which had been left in this closet. The fungi appeared on the surface only, no trace of it could be found in the milk taken from various depths. The milk in the cup kept in the cabinet exhibited no appearance of the Mucor Mucedo or any other vegetable or animal organism; it had become thickened into a pasty mass, with an intensely sour odour. These observations were continued for eleven days, and the only difference observable was in the oil globules—they began to lose their spherical form, as if the investing pellicle had been weakened in parts and had become expanded.

These experiments were repeated with a second supply of milk, which Mr. Kipping kindly supplied, and the results were alike in both cases. The range of temperature during the experiments was from 45° to 63° F. These experiments would lead me to believe that vegetable organisms do not, as a rule, make their appearance in pure unadulterated milk, unless it is exposed for some time to atmospheric influences; most probably the spores are supplied by the atmosphere. Further experiments are wanting to decide the question. The microscopical examinations should be continued in hot weather. I hope to be able to resume the enquiry next summer under different conditions, which have suggested themselves during the examination I have detailed. In any case, M. V. Essling's suggestion to bottle the milk is very good, and, in my opinion, cream pans with covers would be a very great improvement on the open ones as at present employed, at the same time having due regard to the cleanliness of the apartment and vessels in which the milk is kept.

In a microscopical examination such as I have recorded it is quite necessary to have pure materials. The milk as supplied by vendors we know to be very frequently adulterated, and the most simple and easy method is by the addition of water. We know also that in towns where the water has a high character for purity, it sometimes happens in dry hot weather the reservoirs are charged with vegetable and animal organisms. Milk may not always have town's water added to it; in this case there may be an extra quantity of vitalised matter introduced. What a surprising account a microscopist might furnish from the examination of milk containing such an importation! In the cold weather, such as we have at present, animal organisms are not so abundant, and this may account for their absence from a sample of milk obtained in this town, in which I found *Algæ*, but not belonging to the pure milk. One curious circumstance was noticed in this milk, no Mucor Mucedo appeared in or on it, although exposed in the closet for the same length of time as Mr. Kipping's milk, which showed signs of this growth on the sixth day, and on the twelfth day the town milk had none visible. I may mention that pure milk in a bottle securely corked remained fresh twelve days; possibly the low temperature favoured its preservation.

ON THE

ACTION OF CYANOGEN ON ANTHRANILIC ACID.*

BY P. GRIESS, F.R.S.

Some time ago,† I pointed out the action which takes place when cyanogen gas is passed into an alcoholic solution of amidobenzoic acid. The principal product of this reaction is, as I have shown, a yellow compound of cyanogen and amidobenzoic acid, of the formula—

$$C_7H_5(NH_2)O_2,2CN,$$

which separates in large quantities as soon as the alcoholic solution of amidobenzoic acid is nearly saturated with cyanogen. When anthranilic acid (a body isomeric with amidobenzoic acid) is submitted, under the same condition, to the same reagent, a totally different reaction takes place. In this case, the solution remains either perfectly clear, or only traces of a similar yellow compound are precipitated. By allowing the alcoholic solution of anthranilic acid saturated with cyanogen to stand for several days, the acid is almost entirely converted into a new compound of the empirical formula $C_{10}H_{10}N_2O_2$; two other new compounds (an acid and an indifferent body) are at the same time formed. It is worthy of remark that none of these compounds are isomeric with any of the bodies which, by the same process, are formed from amidobenzoic acid. Each of them belongs to a different type.

I propose on this occasion to treat only of the principal product of the reaction—viz., the compound $C_{10}H_{10}N_2O_2$. It is prepared in the following manner:—An alcoholic solution of anthranilic acid is saturated with cyanogen gas, and left to stand for about eight days. The alcohol is then evaporated at a low temperature and the crystalline residue washed several times with dilute solution of carbonate of ammonia, by which any traces of the new acid (one of the by-products of the reaction) are removed. It is then further purified, by re-crystallisation from alcohol, with the addition of a little animal charcoal. The indifferent body already

* A paper communicated to the Royal Society.

† *Zeitschrift für Chemie*, new series, vol. iii., p. 533, and vol. iv., p. 389.

referred to, which is very little soluble in alcohol, is thus separated. The new compound, $C_{10}H_{10}N_2O_2$, is then obtained in the form of white acicular crystals, which are very little soluble in boiling water, but dissolve readily in boiling alcohol and ether. It fuses at 173° C., and can be distilled in small quantities, without undergoing decomposition. Its formation may be expressed as follows:—

$$\underbrace{C_7H_7NO_2}_{\text{Anthranilic acid.}} + \underbrace{2CN}_{\text{Cyanogen.}} + \underbrace{C_2H_6O}_{\text{Alcohol.}} = \underbrace{C_{10}H_{10}N_2O_2}_{\text{New Compound.}} + \underbrace{CHN}_{\text{Hydrocyanic acid.}} + \underbrace{H_2O}_{\text{Water.}}.$$

According to this equation, alcohol, as well as anthranilic acid and cyanogen, take place in the reaction. Confirmatory experiments which I have made show that the compound in question is really an ether.

Action of Hydrochloric Acid upon the Compound $C_{10}H_{10}N_2O_2$.—Ordinary hydrochloric acid dissolves this body, and, when cold, does not act upon it. On boiling, however, speedy decomposition sets in, and a new body separates, the formation of which is represented by the following equation;—

$$C_{10}H_{10}N_2O_2 + H_2O = \underbrace{C_8H_6N_2O_2}_{\text{New Compound.}} + \underbrace{C_2H_6O}_{\text{Alcohol.}}.$$

This new compound, $C_8H_6N_2O_2$, is very difficultly soluble in boiling water, alcohol, and ether, and crystallises in small white brilliant plates. It is likewise dissolved by solutions of caustic alkalies, but is again, however, separated by carbonic acid. On adding a solution of silver salt to its aqueous or alcoholic solution (neither of which has any action on vegetable colours), a white precipitate is formed. Fuming nitric acid converts this body into a nitro-compound, crystallising in honey-yellow prisms, of the composition $C_8H_5(NO_2)N_2O_2$. On treating the latter with sulphide of ammonium, or with tin and hydrochloric acid, it is reduced, and furnishes a basic amido-compound, crystallising in slightly yellowish-tinted needles, difficultly soluble in all neutral liquids. Its composition is $C_8H_5(NH_2)N_2O_2$. Compounds of this amido-body, with acids, crystallise well generally, but are, for the most part, difficultly soluble.

Action of Ammonia on the Compound $C_{10}H_{10}N_2O_2$.—On digesting the body for several days, at 100° C., in sealed tubes, with alcoholic ammonia, it is gradually converted into a base, almost insoluble in water, and difficultly soluble in boiling alcohol. From this it crystallises in brilliant nacreous plates.

Its composition agrees with the formula $C_8H_7N_3O$, and its formation takes place according to the equation—

$$C_{10}H_{10}N_2O_2 + NH_3 = \underbrace{C_8H_7N_3O}_{\text{New base.}} + \underbrace{C_2H_6O}_{\text{Alcohol.}}.$$

This new base is monacid. Its nitrate is especially characteristic, for it is almost insoluble in water and alcohol. It separates out from very dilute solutions of the base, in the form of small white plates, on the addition of nitric acid. Its platinum-salt crystallises in thick yellow needles, and has the composition—

$$2(C_8H_7N_3O), 2HCl, PtCl_4.$$

The compounds just described may, one and all, be viewed as substitution products of anthranilic acid, viz:—

Anthranilic acid.....	$C_7H_7NO_2$	$= C_7H^6NO.HO.$
New ether.....	$C_{10}H_{10}N_2O_2$	$= C_7H_5(CN)NO.C_2H_5O$
Product of decomposition of the former with HCl.....	$C_8H_6N_2O^2$	$= C_7H_5(CN)NO.HO.$
Nitro compound.....	$C_8H_5(NO_2)N_2O_2$	$= C_7H_4(NO_2)(CN)NO.HO.$
Amido-compound.....	$C_8H_5(NH_2)N_2O_2$	$= C_7H_4(NH_2)(CN)NO.HO.$
Base obtained from the ether by the action of NH_3....	$C_8H_7N_3O$	$= C_7H_5(CN)NO.H^2N.$

As I intend taking an early opportunity of considering the rational constitution of these bodies somewhat more fully, I content myself, for the present, with remarking that I am inclined to regard the base $C_8H_7N_3O$ as the creatinine of the benzoic series; it stands to anthranilic acid exactly in the same relation as creatinine *par excellence* does to sarcosine—

$$\underbrace{C_8H_7N_3O.}_{\text{Benzo-creatinine.}} \qquad \underbrace{C_4H_7N_3O.}_{\text{Creatinine.}}$$

$$\underbrace{C_7H_7NO_2.}_{\text{Anthranilic acid.}} \qquad \underbrace{C_3H_7NO_2.}_{\text{Sarcosine.}}$$

Herr Neubauer has shown* that creatinine, when treated in a sealed tube with baryta-water, undergoes the following change:—

$$\underbrace{C_4H_7N_3O}_{\text{Creatinine.}} + H_2O = \underbrace{C_4H_6N_2O_2}_{\text{Methylhydantoine.}} + NH_3.$$

I consider it highly probable that the base $C_8H_7N_3O$ will split up in like manner, with the formation of the above-described compound, $C_8H_6N_2O_2$, according to the equation—

$$C_8H_7N_3O + H_2O = C_8H_6N_2O_2 + NH_3$$

Indeed, this latter compound exhibits great resemblance in its chemical deportment to the methylhydantoine of Herr Neubauer.

In conclusion, I should point out that the azodioxindol described by Herrn Baeyer and Knop, in their paper "On Indigo Blue," is isomeric with the before-mentioned compound, $C_8H_6N_2O_2$. These two bodies show, moreover, great similarity in other respects, so much so that I should feel inclined to view them as identical, if their fusing points did not differ essentially. Herrn Baeyer and Knop state that the fusing point of their azodioxindol is 300° C.; while the compound I obtained fuses above 350° C. Should it turn out, however, on further investigation, that the two bodies are identical, the compound $C_8H_6N_2O_2$ would have to be regarded as the first derivative of indigo which has ever been prepared synthetically, and which, like indigo blue itself, contains 8 atoms of carbon.

ON THE

SUCCESSIVE ACTION OF SODIUM AND IODIDE OF ETHYL ON ACETIC ETHER.†

BY J. ALFRED WANKLYN.

In a remarkable paper which appeared in the *Philosophical Transactions* (vol. clvi., p. 37, 1866), Frankland and Duppa described the products obtained on treatment with iodide of ethyl of the yellow wax-like mass given by the action of sodium on acetic ether. Besides the description of the compounds, Frankland and Duppa give a theory of their origin, which theory

* *Ann. der Chem. und Pharm.*, vol. cxl, p. 26.
† A paper communicated to the Royal Society.

is embodied in four equations, expressive of Frankland and Duppa's view of the origin of the wax-like mass. As I have already pointed out, each one of these four equations affirms the evolution of an equivalent of hydrogen by every equivalent of sodium employed.

It is an established fact that neither acetic ether, nor any other ether, ever evolves hydrogen by reaction with the alkali metals. All equations which assume evolution of hydrogen in these reactions are, therefore, inadmissible.

At the end of my paper in the January number of Liebig's *Annalen*, I promised to give an explanation of Frankland and Duppa's products, which should not involve the assumption of evolution of hydrogen. That explanation I now give.

On reference to Frankland and Duppa's paper just cited, it will be found that the products described by them as obtained from the "wax-like mass" and iodide of ethyl are the following:—

(A). $C_8H_{14}O_3$, liquid boiling at 195° C.
(B). $C_{10}H_{18}O_3$, liquid boiling at 210° C. to 212° C.

butyric ether, caproic ether, and also some unacted-upon acetic ether, and a considerable quantity of common ethylic ether.

The history of these compounds is, therefore, the task set before me.

I have already shown that the direct products of the action of sodium on acetic ether are ethylate of sodium and sodium-triacetyl. Nothing else seems to be produced directly; but the excess of acetic ether, which is necessarily taken, acts on some of the ethylate of sodium, producing alcohol and acetate of ethylene-sodium in the manner described by me on a former occasion. (Of course, the extent to which this secondary action takes place will be determined by the exact circumstances of the experiment.) We have, therefore, in the wax-like mass, got, by prolonging the action of sodium on acetic ether—

Ethylate of sodium.....C_2H_5NaO.
Sodium-triacetyl.....$C_6H_9O_3Na$.
Acetate of ethylene-sodium..$C_4H_7NaO_2$.
Alcohol.....C_2H_6O.

On the first three, iodide of ethyl acts, giving iodide of sodium and organic liquids.

From the ethylate of sodium comes the common ether.

From the sodium-triacetyl comes ethyl-triacetyl, which is $A = C_8H_{14}O_3$, having been got by Geuther from the pure sodium-triacetyl.

From isolated acetate of ethylene-sodium and iodide of ethylene, I have recently obtained liquid B ($C_{10}H_{18}O_3$) thus:—

$$\underbrace{2C_4H_7NaO_2}_{\text{Acetate of ethylene-sodium.}} + 2C_2H_5I = 2NaI + \underbrace{C_2H_6O}_{\text{Alcohol.}} + C_{10}H_{18}O_3.$$

The liquid prepared by me boiled at 212° C., and gave carbonate of baryta with baryta-water, and was identical with Frankland and Duppa's liquid B.

By the action of liquid A upon ethylate of sodium, Geuther has recently shown that butyric ether is produced. Geuther's reaction I write thus:—

$$\text{(A).}\ C_8H_{14}O_3 + C_2H_5NaO = \underbrace{NaC_2H_4C_2H_3O_2}_{\text{Acetate of ethylene-sodium.}} + \underbrace{C_6H_{12}O_2}_{\text{Butyric ether.}}.$$

Finally, I predict that liquid B will give—

$$\text{(B).}\ C_{10}H_{18}O_3 + C_2H_5NaO = NaC_2H_4C_2H_3O_2 + \underbrace{C_8H_{16}O_2}_{\text{Caproic ether.}}.$$

ON MICROSCOPICAL MANIPULATION.*

BY W. T. SUFFOLK, F.R.M.S.

(Continued from Am. Repr., Feb'y, '70, page 60.)

From the explanation already given of the various modes in which light may be polarised, it is evident that one-half of the illuminating power is thrown away by the use of the polarising prism; this loss becomes a very serious matter when high magnifying powers are used, and as much valuable work is to be done by employing polarised light in combination with objectives of $\frac{1}{8}$ inch and shorter focus, it becomes necessary to find some means of increasing the intensity of the illuminating pencil under such circumstances. Polarised light can be concentrated by lenses in the same manner as common light, and, after condensation, still retains its peculiar properties. In large microscopes, provision is made for fitting the Nicol prism below the achromatic condenser, and a set of Darker's selenites between them; this, with a good tourmaline or Herepathite for an analyser, will enable observations to be carried on with very high powers, and with nearly the same ease as by ordinary illumination. With small microscopes, Collins's Webster condenser, which is constructed to carry a Nicol prism, will be found a very efficient illuminator; as its lenses are large, and it supplies an excess of light when used without diaphragms, it will be found very suitable for polarising purposes. Its capability of being adapted to any instrument is another recommendation. The author can speak favourably of its performance with his own microscope, in which the unusually short distance between the stage and mirror prevents the use of any other condenser. The selenites can be placed between the Nicol prism and the condenser, as usual in microscopes with substage fittings, but with small instruments the stage arrangement must be used; the focus of the Webster is sufficiently long to work through the three selenites without material injury to the illumination, when Mr. Bailey's or other thin mounting is employed.

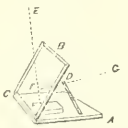
In carrying on observations by the aid of polarised light, it is necessary that the substance to be examined should be rendered as transparent as possible, by immersion in a suitable medium. Those which render objects so transparent that the details are almost invisible under ordinary illumination, are in general very suitable for polariscope purposes.

The facts which polarised light reveals are principally differences of density in tissues, the existence of which we should not be aware of without such aid. With regard to crystals, the polariscope at once distinguishes those which belong to the cubic system, such as common salt, which has no doubly refractive power, and, in common language, does not polarise, from those of the other systems, which, owing to their double refraction, are among the most brilliant of polariscope objects. Not only differences of density are made evident by the use of polarised light, but also minute variations of thickness when the substance examined is possessed of doubly refractive properties, which are at once shown by a difference of colour which defines the boundaries of the thickened portion, although this from the hyaline nature of the substance might be perfectly invisible when illuminated in the ordinary manner. This is

* The substance of a course of lectures delivered to the members of the Quekett Microscopical Club, January—April, 1869.

very often the case with the secondary deposits in vegetable tissues, which are to be seen most clearly when viewed with polarised light and sufficiently high powers. Sections of such substances as horn and tissues resembling it, as whalebone, &c., which exhibit little or no structure with common light, at once display differences of density indicated by colour when examined with the polarising microscope. A very interesting microscopic object is made by Mr. Bailey, consisting of a bar of glass, which is capable of being pressed by a screw. This, when examined by polarised light, exhibits no doubly refractive appearances so long as the screw does not touch it; but when pressure is applied, dark or coloured bands make their appearance around the point of the screw, extending to a greater or less distance, according to the amount of pressure employed, showing at once that some change has taken place in the molecular arrangement of the glass. Nearly similar bands are to be seen along the sides of a recent diamond cut and around the dot made by a slight blow of a steel centre punch, in both cases showing that the glass has been subjected to some strain. Opticians, in fitting lenses into cells, are careful to avoid pinching the glass, lest double refraction should be produced. Coloured bands are easily seen in pieces of thick plate-glass which have been rapidly cooled. These are best shown in Lecount's polariscope (Fig. 38), in which the polarised ray, G, is made to pass

Fig. 38.



twice through the piece of unannealed glass, F, which very much increases the intensity of the coloured bands. In this simple instrument the bundle of glass plates, B, acts as a polariser by reflection, and at the same time as an analyser by refraction, the light being reflected from the bundle through the object, and returned through it by the mirror, C, the bundle analysing the polarised ray, F, on its passage through it to the eye at E. The colours produced by varying thicknesses of selenite may be seen with the microscope in a small piece, roughly split, and mounted in balsam. It will be found that there will be a change of colour at every difference of thickness.

The object should be viewed, in the first instance, with the selenite plate, and the appearances noted which present themselves when both analyser and polariser are rotated. If the construction of the microscope permit, the object itself should also be rotated. Should no effect be produced by the prisms alone, a selenite may be used, commencing with one of little retarding power as ¼ of Darker's series. This should be rotated, and also the prisms before going through the various degrees of retardation.

Substances having a very feeble doubly refractive power are much assisted by using a selenite of suitable thickness, and details are often better seen with selenites of one colour than another. Darker's series offers great facilities for readily obtaining the most suitable tint. When a less power than that given by the ¼ is required, it can be obtained by turning the plate more or less towards one of the optic axes, which are situated at 45° from the P. A. mark, and the other depolarising axes. Also by using plates of mica, thin enough to just let a little light into the darkened field. Care should be taken to use sufficient light, and employ the condenser whenever necessary. As a general rule, with high powers, the light cannot be too strong; sometimes direct sunlight may be used with advantage. The effect of increase of illuminating power with the polariscope is not that of dilution, like excess of light pouring through a transparent coloured object, but as the coloured wave is augmented, intensity of colour and stronger definition is the result.

The polarising microscope is a great aid to the knowledge of structure, and an examination cannot in any way be considered as complete in which this most searching mode of investigation has been neglected. Hitherto, the polariscope has been considered rather in the light of a toy than as a valuable instrument of research, and it has therefore become necessary to devote so much of this elementary course of instruction to the application of polarised light to microscopical purposes.

The processes of recording microscopical observations are scarcely less important than those employed in making them. The facts accumulated by the most painstaking observers are of comparatively little use unless means are found of preserving and communicating them to others. This is particularly the case with regard to microscopical studies, and, like most natural-history observations, written descriptions, however graphic, are scarcely intelligible unless accompanied by truthful drawings. The concluding portion of these papers could, therefore, hardly be considered as complete without some mention of the way of writing this language of all nations, a subject which has, with a few exceptions, met with but little attention from writers on the microscope; probably being very expert themselves, the idea prevailed that drawing was as natural an acquirement as writing, and that no special directions were needed. The lectures which supplied the matter for these pages being intended for persons wholly unacquainted with the use of the microscope, it was then deemed advisable to treat upon the subject of microscopical drawing and micrometry at greater length than usual, dwelling especially on those points upon which little information is to be found in books; and the author has seen no reason to alter his opinion since the delivery of the lectures, but has rather added than withdrawn matter.

Photography, from its extreme accuracy and delicate rendering of details, claims a very high place among the resources of microscopical art. When the object is suitable for its employment, the result is not to be equalled by any other means of delineation. The conditions, however, which it is requisite to comply with in order to obtain a successful micro-photograph somewhat limit the cases in which it is available. The object to be photographed should be very thin and flat, so that the whole, or the greater part of it, lies in the same plane, that it may all be in focus at once; the reduction of aperture commonly used by landscape photographers to secure focal depth not being practicable, on account of the great loss of light occasioned by the use of small diaphragms, which is so great when the object is much magnified as to render the production of an impression on the prepared plate impossible with any reasonable amount of exposure. This is a very great drawback, as many of the most interesting microscopical objects can scarcely be seen without continual alteration of the

[English Edition, Vol. XXI, No. 528, page 9; No. 529, pages 19, 20.]

focal adjustments. The colour of the object should also be such as is favourable for photographic purposes; the yellow, brown, and red tints of many tissues render it impossible to obtain any satisfactory result. The best photographs are always those obtained from colourless objects, such as the *Diatomaceæ*, the delicate sculpture on the frustules of which are marvellously rendered, as may be seen by examining the photographs by Dr. Maddox, to be procured of Mr. How, of Foster Lane, at a merely nominal price. So minutely are the details produced that they will, when photographed upon glass, bear a considerable amount of enlargement by means of the magic-lantern.

At present only objects illuminated by transmitted light have yielded impressions on the prepared plate, the more feeble images obtained from reflected light and dark field illumination have failed in producing photographs, and so a large and interesting class of objects is excluded. Possibly future improvements may remove this, and some other difficulties which at present limit the use of this valuable art. The necessity of employing special apparatus and of mastering a delicate set of chemical processes will, it is to be feared, prevent many microscopists from availing themselves of photography as a means of delineating the objects presented to them in the course of their studies.

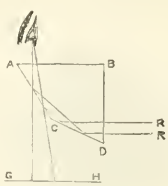
The practical details of manipulation and the bibliography of the subject are treated at considerable length in Dr. Beale's "How to Work with the Microscope," 4th edition, pp. 229 to 279.

Fortunately, the other processes used in making representations of objects are within reach of the majority of microscopists. The apparatus being simple and inexpensive, compared with that needed for obtaining photographs, and the use of it so easily mastered, that, with a little perseverance, most persons will be found able to obtain drawings really useful, although, perhaps, somewhat wanting in finish and delicacy. Even these may be attained in some degree by painstaking application; and, although the student's productions may not equal the work of professional artists, they will be found to possess an amount of truth which would most likely be wanting in the work of a more accomplished but less scientific draughtsman.

The simplest, but not the easiest, method is to make the drawing without instrumental aid. Few but those who are expert draughtsmen can accomplish this. The difficulty of obtaining anything approaching an accurate representation can only be understood by those who are familiar with the process. The chief obstacle is the impossibility of seeing object and drawing nearly together, as in landscape or other sketching, and the consequent trouble occasioned by frequently losing the place, especially during the earlier stages of the outline; the peculiar view afforded of the object depriving the observer of those guides used in ordinary drawing from nature. The impossibility of making the drawing to scale is another disadvantage, and renders it of but little value as a microscopical record. For objects in active motion no other mode is available, and in such cases it is of value, also, for making slight sketches and memoranda during observations, and preserving facts which would otherwise be lost; but where considerable accuracy is needed some one or other of the instrumental appliances now to be described must be employed. Nearly all the instruments attached to the microscope with a view to aid delineation act upon the principle of rendering the image of the object and the paper and pencil-point visible together and apparently blended. This may be accomplished in several ways, although the principle of reflection is used in all cases.

The oldest of these instruments is the *camera lucida* of Dr. Wollaston; it consists of a four-sided glass prism (Fig. 39), of which the angle A, B, D equals 90°, the

Fig. 39.



angles B, A, C, and B, D, C, 67° 30′, and the angle A, C, D, 135°; it acts by twice reflecting the rays R and R, proceeding from the eye-glass of the microscope, which enter through the side B, D, first at C, D, and afterwards at A, C, to the eye, so placed at A that one-half of the pupil is over the edge of the prism, and views the image of the object in the microscope, the pencil and paper being seen by the other half, which is placed beyond the edge A. As the reflections are internal,* there is scarcely any loss of light; the image is consequently very bright, and owing to its being twice reflected, it is not inverted when it reaches the eye. The prism is mounted in a convenient setting, so that it may be fitted over the eye-piece in the place of the cap, which is of course removed. A lens is sometimes attached to the lower part of the camera lucida, between the eye and the paper; this is of use to persons who cannot see the drawing distinctly at the usual distance, about ten inches, and may be either convex or concave, according to the special requirement of using it.

A small steel disc, known as *Soemmering's mirror*, placed at an angle of 45°, is used by some microscopists. The polished disc is smaller than the pupil of the eye; so that, while the image from the microscope is viewed by the centre of the pupil, its circumference is employed in viewing the paper and pencil point, upon which the image appears to be projected, as in the camera lucida.

Another contrivance, and one which has the recommendation of being procured at a very small cost, is the *neutral tint reflector* (Fig. 40). It consists of a small plate of glass, with surfaces accurately parallel and slightly colored, so as to improve its reflecting qualities, but not sufficiently dark to prevent the paper from being easily seen through it. This is placed, as before, at an angle of 45°. As the instrument is commonly constructed, the tinted glass is a fixture, and the setting too long; so that the mirror is removed to a greater distance than is advantageous from the front glass of the eye-piece; this contracts the field so much, when any but an eye-piece of low power is employed, that it is almost useless. This defect is remedied in the form here represented, in which the mirror is brought as close as possible to the eye-glass. The tinted glasses are also removable, so that a change of tint may be made, as it will be found sometimes that one tint suits the eye better than another. Some microscopists,

* Chemical News, vol. xx., p. 266. (*Am. Repr., Feb.* 1870, *page* 54.)

instead of tinted glass, use a piece of thin cover-glass, which gives a very good reflection, and can easily be used with this form of setting, which also allows a small right-angled prism to be placed in it, and which, although not usually supplied with the instrument, will be found a serviceable addition. Its use will be described with that of the preceding instruments. This reflector gives a reversed view of the object by a single reflection, as in the steel mirror of Soemmering, but, unlike it, the paper, instead of being viewed round its edge, is seen through the glass.

As these instruments have much in common, the use of them may very conveniently be described together, noticing, in passing, such peculiarities as render them more or less serviceable, each having its own special advantages and defects.

Fig. 40.

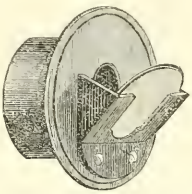
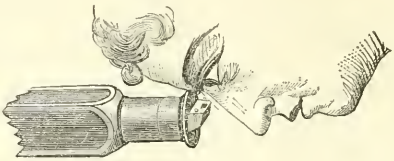
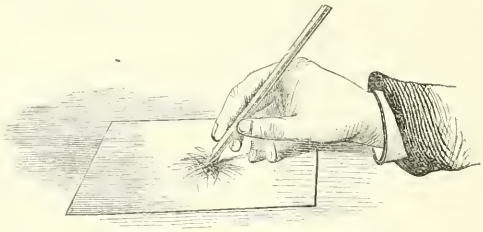


Fig. 41.



The microscope should be placed with the body in a horizontal position (Fig. 41), and, if the stand is not of suitable height, it should be placed on a box or other convenient support. The best distance between the eye and the paper, for general purposes, is 10 inches, this being the standard distance employed in estimating magnifying power; but any other that is convenient may be made use of, bearing in mind that the greater the distance from the eye-piece the larger will be the image; so that the size of the picture is capable of being regulated at will, the only limit being the difficulty of seeing the pencil when too near, and the trouble of drawing with a pencil attached to a long stick if the paper is greatly removed from the usual position.



With respect to the images formed by the several instruments, the camera lucida, as it reflects doubly, has the advantage of giving the image in the same position as when viewed through the microscope directly, which, owing to its perfect internal reflection, is brilliant and well defined. Soemmering's mirror and the tinted-glass reflector reverse the image, just as an ordinary looking-glass. This is of little consequence if only slight outline sketches are required; but, when the drawing is to be highly finished, which is always done by viewing the object directly through the microscope, this reversal becomes excessively troublesome to those who are not, like engravers and lithographers, accustomed to reverse their drawings.

With a view to obviating this inconvenience, the author uses the small right-angled prism before mentioned, when drawing with the neutral tint reflector, which enables the drawing to be completed, as it reverses the image just as the tinted glass; and, as the reflection from the internal surface of the prism is total, the view is nearly as brilliant as that received directly from the microscope.

Only one eye is to be used while drawing, and great care should be taken to maintain its position steadily until the sketch is finished (Fig. 41). With the camera lucida and Soemmering's mirror, the maintenance of this position is somewhat painful, when much prolonged, owing to the divided manner in which the eye receives the light from the object and the paper; and frequently the power of seeing the pencil and drawing is lost after a few minutes' use. With the neutral tint reflector, the view of both object and paper is much easier; and, when the reversal of the picture is immaterial, it is, as far as comfort is concerned, much to be preferred.

The illumination is a matter of great importance in making use of drawing instruments. Care should be taken not to light the object more than is necessary, while it will generally be found advisable to illuminate the paper rather strongly. If the image of the object is too bright, it will be found impossible to see either the pencil-point or the line it is tracing. The camera lucida requires far more care, in this respect, than the tinted mirror.

The author's practice is always, when drawing, to use two lamps; one the little camphine lamp before mentioned (Chemical News, vol. xx., p. 158; *Am.*

Repr. Dec. 1869, *page* 322), which is used exclusively for the microscope; the other a large paraffin lamp, with shade, which lights the paper. By this means, the relative illumination of the object and paper can be very nicely adjusted—a matter of some difficulty when only one lamp is employed.

These instruments are only used to secure an outline, and mark out other main points, the details being filled in by free-hand drawing, which will be found comparatively easy when an accurate outline is obtained to work upon.

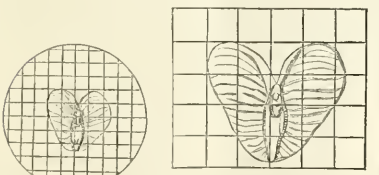
If, when the sketch is finished, before removing the reflector, a ruled micrometer-scale is placed upon the stage of the microscope in the place of the object, the lines can be seen projected upon the paper, just as any other object, and, by tracing some of them, a scale can be formed by which the drawing can readily be measured with a pair of compasses, like a map. This is one of the simplest methods of micrometry.

The magnifying power of the microscope can also easily be ascertained by means of the camera lucida or neutral tint reflector and the stage micrometer. By placing the microscope in the position for drawing, taking care that the eye-piece is 10 inches from the paper, the image of the micrometer-lines, instead of being projected on a sheet of paper, is caused to fall upon a divided scale; and, from the amount covered by it, the magnifying power can be estimated; for instance, the 1-inch objective, with No. 1 eye-piece, causes 0·01 of the micrometer to cover 0·5 inch of the measure on the table; the magnifying power will be 50 diameters. The ¼-inch makes 0·01 cover 2·5 inches; the power will be 250 diameters. And so on, for other objectives and eye-pieces.

Finding the placing of the microscope in a horizontal position troublesome, and not liking the constraint of the camera lucida, the author thought that the method of enlarging and reducing drawings commonly employed by artists might be adapted to the microscope. This process consists of ruling a series of squares of convenient size on the drawing to be copied, or placing over it a lattice of threads crossed in squares. The copy is then made upon a sheet of paper or other material, ruled, either in augmented or diminished proportion, as may be required. Messrs. R. and J. Beck ruled a disc of glass in squares (Fig. 42), the side of each of which, for convenience sake, was made to correspond with 10° of Jackson's eye-piece micrometer. This disc was dropped into the eye-piece, and rested on the stop, so that, when in use, the field appeared similarly divided (Fig 42, A). A sheet of paper (Fig. 42, B), ruled in squares of convenient size, was employed to make the drawing upon; and, by noticing how many squares the object covered, the direction of the various lines, whether, for instance, they ran through the sides or the corners of the squares, and setting them down in similar positions on the ruled sheet, the author found that an accurate drawing might be made with great ease and expedition, and without the trouble of moving the microscope out of the usual inclined position, which is generally the most comfortable for observation. The use of the binocular did not cause any impediment, and the ruled disc only slightly interfered with the definition of the object, and could easily be removed, when its services were no longer required, without disturbing the arrangement of illumination, object, or instrument. When large diagrams are wanted, nothing more is necessary than to use a large sheet of paper, ruled in squares of suitable dimensions, and the object can be rapidly delineated in this augmented proportion.

Fig. 42.

A. B.



The measurements can be made either by obtaining the value of the side of a square of the disc with each objective and eye-piece, by means of the stage-micrometer, or by selecting two well-marked dots or lines in the objects, and measuring their distance with the eye-piece micrometer, and using the distance obtained from the corresponding part of the drawing as a standard for the formation of a scale. These processes will be explained in the account shortly to be given of micrometers.

When many sheets of paper are required to be ruled in squares (and it will be found in practice that two or three sizes will be in general request), they can easily be made by placing a perforated sheet over the sheet to be ruled, and rubbing over it a piece of wash-leather dipped in black-lead powder, which will pass through the holes and leave a series of dotted lines on the sheet below, which will be sufficiently distinct, and have the advantage of being rubbed out with a very light touch of the india-rubber, without affecting the pencil-lines of the drawing. The perforated sheets are easily made by means of a comb-like steel punch used by harness-makers, which cuts a row of small pin-holes, equal in length to its own width, which may be an inch or more. This instrument can be obtained at the better class of tool-shops.

Some microscopists have endeavoured, with more or less success, to make drawings from the image of the object projected upon a sheet of paper or ground glass, after the manner of the solar microscope or camera obscura. All the contrivances for this purpose seem to have the defect of giving a very faint image, unless a light of greater intensity than that of ordinary lamps is employed. The image must be received in the dark, which is troublesome, as the outline cannot easily be seen. The process is only applicable to those objects which can be viewed by transmitted light, besides putting the microscope more out of its usual position than the camera lucida and other reflecting instruments.

Intimately connected with microscopical drawing is the subject of micrometry, the practice of the two together forming the records and statistics of histological science. The contrivances used by the earlier observers were rude in the extreme. Leeuwenhoek compares the dimensions of magnified objects with grains of sand. Dr. Hooke, with a little more approach to exactness, used fine silver-wire. By winding a quantity of this closely round a thicker wire, he noticed how many coils there were in an inch, and used the unit so obtained as a means of measurement. The most perfect of the old micrometers is a somewhat

complicated contrivance attached to a microscope by the famous Benjamin Martin, now in the possession of the Royal Microscopical Society. It consists of a separate stage, which is placed on the instrument when measurements are required to be taken. The object is capable of being moved through a definite space, by means of delicate screws, having large graduated heads, upon which the distance traversed by the object can be read off. This micrometer has, in common with all measuring instruments applied to the stage, the defect that any error in the graduation is multiplied by the whole magnifying power of the instrument.

The standards employed in microscopic measurements are the ruled slips of glass before-mentioned. They are graduated by a machine invented by the late George Jackson, and are now to be obtained of most opticians. They are ruled in hundredths and thousandths of an inch, and are marvellously accurate in their divisions, and extremely fine in the engraving of the lines, bearing a very high magnifying power without appearing coarse. Scales are also ruled in millimetres. The millimetre equals 0·03937 English inches, or about 1-25th of an inch. As the metric system will probably in a few years be universally adopted, it is well to place both scales on microscopical drawings, especially as this system of measurement is common on the Continent.

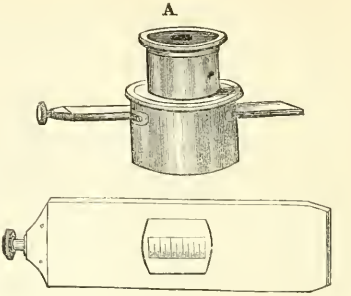
One method of measurement has already been mentioned in describing the use of the camera lucida.

To obtain the greatest degree of accuracy in microscopical measurements, it is desirable that, while the object to be measured is magnified as much as possible, the measuring scale should be but slightly enlarged. This is effected by the use of eye-piece micrometers. The most delicate of these is the well-known *cobweb micrometer* of Ramsden. It is nearly similar to that employed in astronomical instruments, and consists of a positive or Ramsden's eye-piece, in the focus of which is placed a pair of stretched cobweb-lines, one of which is fixed, and the other moyable by means of a fine screw which has a large graduated head. The value of the graduations has to be determined for each object-glass, as is the case with all similar contrivances. The cobweb micrometer, when used with a sufficiently high power, is capable of measuring extremely small portions of space with great exactness; the instrument, however, is rather expensive.

With a view to avoid the multiplication of apparatus, the late George Jackson, by a simple contrivance, rendered the ordinary Huyghenian eye-piece available for micrometric purposes. A slit was cut on each side just above the diaphragm (Fig 43, A), which served to admit a brass slide, B, containing a scale ruled on glass, which, when in position, was in the focus of the eye-glass, and could be seen in the field at the same time with the object in the microscope. The scale is ruled with a long line at every fifth division, and a still longer one at every tenth, for facility of reading. The scale is allowed a small amount of lateral motion, which is controlled by a fine screw acting against a spring on the opposite side. This movement enables the line from which the measurement commences to be brought to the edge of the object more accurately than it could be by means of the stage movements, as the scale of the eye-piece micrometer is only magnified by the trifling power of the eye-glass, while the motion of the stage-racks is enlarged by the whole power of the instrument. The operation of measuring is nearly as easy as applying an ordinary rule: the scale is brought over the object, adjusted by the screw, and the number o degrees read off in the direction required.

Fig. 43.

A



B

To determine the value of the degrees, which differs with each objective, the following process must be adopted:—

Place the micrometer in its eye-piece, and focus, if necessary, for distinct vision of the scale by unscrewing the eye-glass, which is usually provided with a rather long screw for this purpose. Screw on the objective, and place the ruled scale on the stage; and, looking through the microscope, focus until the lines are sharp and distinct. Suppose the value of the micrometer is to be ascertained for the $\frac{2}{3}$ object-glass, and it is found that 1-1000th of an inch of the ruled scale on the stage occupies a little less than two divisions of the micrometer, this will give an awkward number for calculation; so it will be necessary to increase the power of the microscope to such an extent that the 1-1000th should occupy 2 exactly. This can be done by lengthening the body by means of the draw-tube, which, for this purpose, should be divided into inches and tenths, that the amount of extension may be noted. The tube is to be drawn out until the divisions of the stage micrometer coincide with those of the eye-piece micrometer. Say, for example, it is found that, to effect this, the tube has to be lengthened 3-10ths of an inch; then, as 1-1000th of an inch equals 2 of the eye-piece micrometer, 1° is equal to 1-2000th of an inch. This process should be repeated with each object-glass, and tried several times to ensure accuracy. The result should be preserved in the following tabular form:—

Value of Divisions of Eye-Piece Micrometer.

Objective.	Draw-tube.	Vulgar Fraction.	Decimal.
$1\frac{1}{2}$	13	$\frac{1}{1000}$	·001
$\frac{2}{3}$	3	$\frac{1}{2000}$	·0005
$\frac{1}{10}$	22	$\frac{1}{4000}$	·00025

And so on through the whole series of objectives. The slight alteration of distance between the anterior combination and the back lenses caused by turning the graduated collar which regulates the adjustment for covering glass with the higher powers, slightly alters the magnifying power; and, when very accurate measurements are required, the draw-tube correction must be ascertained for each degree of the adjustment-

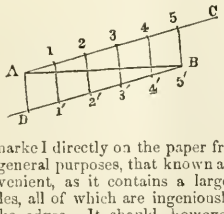
collar. The value of the divisions of the Ramsden's or cobweb micrometer is calculated in the same manner. When this table is once made, measurement with the eye-piece micrometer becomes very easy indeed. After selecting the object-glass and placing the micrometer in the eye-piece, draw out the tube. The number of tenths indicated in the table, and then the degrees, can be read off just like an ordinary measure. To secure accuracy in measuring, always use the highest convenient magnifying power, as the readings can be made with greater minuteness; for instance, a degree with the 4-10th or ½ equals 1-4000th of an inch; while, with the ¼, it would be 1-16000th, and half a degree can easily be estimated by the eye; so, by using the higher power, 1-32000th of an inch can easily be measured, and greater minuteness still can be obtained by using higher powers, where practicable.

A convenient mode of measurement has been devised by Dr. J. Matthews. It is an adaptation of the indicator, sometimes placed in the eye-piece to mark a spot in the field. Two of these pointing needles, suitably curved so that they act, by means of milled-heads, like a small pair of callipers, are placed as just mentioned. The distance on the object is measured between these points, and, upon the removal of the slide, the value of the space can be estimated by putting the stage micrometer in its place. For counting striæ and other marks in a given space, and for many purposes, this simple contrivance is very effective, as, also, where the glass of the stage micrometer might interfere with the definition of a very delicate object.

In making the scales on microscopical drawings, it is often necessary to divide a given space into a certain number of equal parts. When the number is a multiple of two, it is readily performed by a continued process of bisection; but, as ten is a number frequently required, this process will not serve beyond the first bisection, which leaves five—a rather troublesome number to guess at with the compasses. Suppose the line A, B (Fig. 44) is to be divided into five parts. From A, rule the line A, C at any convenient angle, of any suitable length; from B, rule B, D parallel to A, C; from A, set off, with the compasses, five equal spaces (1, 2, &c.) towards C; and, from B, set off the same towards D; join 1, 1′; 2, 2′; 3, 3′, &c.; and the lines 1, 1′, &c., will divide A, B into five equal parts. Any number of divisions may be made by setting off the number required on A, C and B, D.

If scales are employed for setting off distances, those known as "feather-edged scales" are to be preferred, as they do not require the use of compasses, the divi-

Fig. 44.



sions being marked directly on the paper from the thin edges. For general purposes, that known as a builder's scale is convenient, as it contains a large number of different scales, all of which are ingeniously contrived to read at the edges. It should, however, have the sub-divisions in tenths, and not, as usually made, in twelfths. A millimetre scale will also be found useful.

(To be continued.)

ON A MINERAL FROM SAN PAOLO.

BY DR. T. L. PHIPSON, F.C.S.,

MEMBER OF THE CHEMICAL SOCIETY OF PARIS.

A mineral from San Paolo, Brazil, was placed in my hands a short time ago in Paris; it was supposed to be a silicate of yttria, and was called Thelline or Thelite. It corresponded in appearance and properties with the silicate of yttria, described by M. Damour, in 1858, as having been found in the diamond sands of Bahia, Brazil; a brown mineral, said to be "probably a silicate of yttria," which whitens before the blowpipe, but does not fuse, and was found to be insoluble in phosphorus-salt.

A small sample of the specimen from San Paolo was confided to me for analysis, with a request that I would make known the result at an early opportunity.

The following is a description of the mineral and its analysis:—It is of a light brown colour, translucent on the thin edges, and in the veins which traverse its substance; when pulverised it gives a light yellow powder of great brilliancy, which becomes bright red when heated; it is partially attacked by strong acids. Before the blowpipe it is infusible, but darkens and turns black in the inner flame, and, by continuing the heat for some time, the surface becomes quite white. It scratches glass like a diamond, and cuts it very nearly as easily as the latter, but it will not attack quartz; it gives flashes and sparks of fire when struck smartly in an agate mortar; it is quite devoid of crystallisation, and its fracture is imperfectly conchoidal. No trace of yttria could be obtained from this mineral, but it was found to contain about 1 per cent of glucina as an accidental constituent. It yielded—

Silicic acid	90·90
Water	4·54
Peroxide of iron and alumina with about 1 per cent of glucina	4·56
	100·00

The presence of glucina in this mineral, which is evidently a kind of hydrated silica, menilite, or resinite, is rather interesting, and leads me to believe that this earth will be found in other natural kinds of silica. Silicate of glucina (Phenakite) is so closely allied to quartz in appearance and crystalline form that it is easily mistaken for it, and substances possessing, when crystallised, the same crystalline form are often found together in nature. I do not conclude from the above that the mineral I have examined is identical with M. Damour's silicate of yttria, for I am not aware that I have ever seen the latter. Doubtless he will some day publish an analysis of it.

Analytical Laboratory, Putney, S.W.

BEET-ROOT SUGAR.

When the Berlin apothecary, Marggraf, in the year 1747 made known, at a meeting of the Royal Prussian Academy of Sciences, the fact that the beet-root contained sugar identical with that derived from sugar-cane, and that he had obtained, by means of alcohol, 6·2 per cent of sugar from the white variety of beet, and 4·5 per cent from the red-coloured root, he certainly did not dream that, within a century after his discovery, the manufacture of beet-root sugar would have become one of the

[English Edition, Vol. XXI., No. 531, page 39; No. 529, page 13.]

most extensive of what is very properly termed, in the German language, *landwirthschaftliche Gewerbe*, but for which no very good translation can be given. It is too much the fashion to take it for granted that manufacturing industry ought to be chiefly confined to larger centres of population; but this notion is not entertained on the Continent, where, beside beet-root sugar making, the preparation of madder and various derivatives therefrom is conducted in the country, rather than in towns. This is also the case with the distillation of spirits from wine, as well as that obtained from various other sources—viz., potatoes, beet-roots, cherries, &c.

The proposals made by M. Marggraf to obtain sugar from beet-roots on the large scale did not then meet with any success, owing to a variety of concurrent causes, among which may be mentioned the cheapness of cane-sugar, imported into Germany from this country and Holland. About the end of last century, Messrs. Achard and Hermbstädt again called attention to this subject, and succeeded on a sufficiently large scale in obtaining from beet-roots about 6 per cent of crystallised sugar and 4 per cent of molasses. It was, however, mainly due to the political disturbances and wars of the latter end of the last and the first fifteen years of the present century that the manufacture of beet-root sugar was entered into commercially. This was principally due to the encouragement of Napoleon I., aided by the eminent judgment and sound scientific knowledge of one of his ministers—the famous Chaptal. It is true that, almost immediately after Napoleon's fall, the beet-root sugar industry collapsed—but only to be revived on sounder scientific and mercantile principles, its temporary collapse being partly due to the protective tariffs made in favour of colonial sugars; whilst, in some countries, beet-root sugar making was practically prohibited, also, by absurd and injudicious excise regulations.

The plant known as *Beta maritima* (an unsightly biannual vegetable, which grows wild on the coast of the Mediterranean in Spain, Dalmatia, and some parts of France) is the mother plant from which the sugar-yielding beet has been derived. The well-known red beet is a different variety of the same genus. The beet has been an object of regular cultivation as a suitable cattle-fodder only from the beginning of this century, since which time several varieties have been obtained, partly as a result of cultivation, partly, also, as a consequence of climate and soil. The *Beta cicla*, or so-called white Silesian beet-root, is considered by many as the best variety for the production of sugar. This root, as well as the other varieties, is a biannual plant. The first year after sowing it only produces rootlets and leaves; in the second year of its growth, the root becomes developed; and, were it not that this vegetable cannot very well stand frost, the best period for its gathering would be in the spring following its second winter. This condition, however, cannot be complied with, and the crop is gathered in the autumn. The weight of the crop of roots gathered from one hectare varies, as might be expected, considerably; but the following figures may give some idea of this subject:—In Austria, from 416 to 580 cwts., yielding from 3080 to 4336 lbs. of sugar; Bohemia, from 448 to 580 cwts., yielding from 3344 to 4640 lbs. of sugar; Prussia, about 720 cwts., yielding about 5344 lbs. of sugar; France, 596 cwts., yielding 4464 lbs. of sugar. The composition of a good kind of the *Beta cicla*, in 100 parts, is:—Water, 83·5; sugar, with a trace of dextrine (about 0·1), 10·5; ligneous fibre, 0·8; albumen, casein, and other albumenoid substances, 1·5; fatty matter, 0·1; organic substances—viz., pectine, citric, and pectic acids, a substance which, in contact with air, assumes a rose colour, asparagin, oxalates and pectinates of lime, potassa, and soda; inorganic salts—viz., nitrate and sulphate of potassa, chloride of potassium, phosphate of lime, and magnesia, all together, 3·7 per cent. It is evident that the juice obtained from a plant of that complex composition is a somewhat difficult fluid to deal with for obtaining sugar therefrom; and, in order fully to illustrate the triumph of well-applied science in this respect, we quote, for comparison's sake, the percentage composition of sugar-cane:—Sugar, 17·8; water, 72·0; cellulose, 9·8; saline matter, 0·4.

There are various processes in use for obtaining sugar from beet-root; but the following is an outline of the general mode of operating:—The roots are dug up, and the head bearing the leaves (which serve together as fodder) is cut off commonly on the field. The roots are then carted to the sugar works and there washed by machinery, it being essential that neither clay nor pebbles should remain adhering, since these might injure the machinery by which the roots are next made into pulp, by being torn up by very sharp circular saws, placed close together on a revolving cylinder, making from 1000 to 1200 revolutions per minute. The pulp is placed in bags made of a very strong linen tissue, and from twenty-five to fifty of these bags are placed on each other on the movable plate of a hydraulic press, care being taken to place between every two bags a frame wicker-work or perforated tinned-iron plates. The pressure which can be applied averages from 500 to 700 lbs. per square inch; generally the pressing process is repeated, sometimes with, sometimes without previous moistening of the cake, which, in some cases, is also broken up again. Before we follow the juice obtained by this pressure, we may pay a moment's attention to the cake obtained after it has been submitted to repeated pressure. It exhibits a hard, somewhat plank-like appearance, varying in size with the size of the press-plate, and about ½ or ⅝ of an inch thickness. It contains, according to an analysis made at Hohenheim*:—Water, 15·61; ash, 1·27; cellulose, 1·47; sugar, 1·72; carbohydrates (starch, &c.), 2·84; proteine compounds, 0·28: together, 23·2. To which add, to make up the 100 parts of beet-root, 76·8 per cent of juice, containing:—Water, 65·95; sugar, 10·17; carbohydrates, 0·63; proteine compounds, 0·58. The cake is used as fodder for cattle, or, in some cases, for the manufacture of brandy, vinegar, and, last, but not least, for the manufacture of paper, for which it is increasingly in demand.

The juice, as it runs from the press-plate, is led, by means of gutters, to what is termed a *monte-jus*, and by its means (by steam) forced up to the defecation-pan, wherein it is rapidly heated, by means of steam (the pan being jacketed), to 85°. This temperature having been reached, a thin milk of lime is added, and the fluid thoroughly stirred up. The lime saturates the free acid present in the juice, and precipitates as well as decomposes the albuminous substances, ammonia being consequently evolved. In order that the lime should act properly, it is necessary to increase the heat, which is

* This place is situated near Stuttgart, in Wurtemberg, and is one of the largest and the best conducted agricultural colleges in Europe. It is fitted up, not only for theoretical, but also for practical instruction, and contains a model beet-root sugar work, brewery, distillery, and other manufactories belonging to the class termed, in Germany, *Landwirthschaftliche Gewerbe*, on a sufficiently large scale for practical use.

raised to near the boiling point of the fluid. The quantity of lime added depends upon the quality of the roots, but is generally about from 1 to 2 lbs. for every 100 litres of juice. The liquor in the defecation-pan is run off clear from the supernatant scum, by means of an ingeniously-contrived tap, and, previous to reaching the animal charcoal filters, the fluid is filtered through a peculiar kind of flannel, made on purpose. The defecated juice is not a pure solution of sugar; it contains saccharate of lime, free sugar, free potassa, soda, and some ammonia; small quantities of organic nitrogenous substances, and sulphate and nitrate of potassa. The removal of a portion of these impurities is effected, in many instances, by filtration through animal charcoal, next submitted to the action of a current of carbonic acid, whereby the saccharate of lime is decomposed; and the clear liquid is evaporated to a density of 24° to 25° Beaumé (sp. gr., 1·199 to 1·210), and again filtered over animal charcoal, in order to remove from the liquid (technically, *clearsel*) colouring matter and other impurities. The filtered juice should have the colour of pale Sherry, and be free from any suspended impurities. The filtered liquor is next evaporated to a density of about 42° Beaumé (sp. gr., 1·412). This evaporation is best performed in a vacuum-pan. When the proper degree of concentration has been attained, the thickish magma (a mixture of crystallised sugar and syrup or molasses) is run into a copper pan, technically termed a cooler; but this is in so far a misnomer, as the contents of the pan are heated by steam to a higher temperature (above 120°) than was attained in the vacuum pan. The contents of the pan are kept in constant motion, by means of stirring, while a gang of men are busy carrying the pasty mass to the sugar-loaf forms, in order therein to solidify, and to be deprived of adhering syrup by being washed with a solution of pure sugar, sufficiently concentrated for it not to dissolve any crystallisable sugar, while effectually removing the molasses. Instead of this rather expensive process, which yields refined sugar, it is often omitted, and in its stead is substituted the use of the centrifugal machine, or, also, of the so-called Schutzenbach boxes (iron tanks, with a false bottom made of wire-gauze, upon which the magma, after it has been heated in the coolers, is run), and there left for several days, until the molasses have entirely run off; the produce being raw beet-root sugar, which is not fit for consumption until it has been refined, even if its colour is only pale yellow.

The molasses from beet-root sugar are unfit for use as sweetenings, owing to the large quantity of mineral salts they contain. According to Meitzendorf, these molasses consist, in 100 parts, of:—Water, 10·8; mineral salts, 10·5; proteine compounds, 9·8; sugar (cane-sugar and non-crystallisable sugar), pectin, fatty matter, caramel, and other undetermined organic substances, 68·9. This material is employed for the manufacture of spirits, which, however, are not at all agreeable to the palate, but might be rendered pure by re-distillation with quick-lime and the use of freshly-ignited wood-charcoal. The residue of this distillation is a valuable source of potash. In Russia and some parts of Silesia the molasses are used, along with other fodder, for the cattle—a practice which deserves encouragement.

The Continent of Europe contains 1184 beet-root sugar works situated in Germany, France, Russia (inclusive of Poland), Austria, and Belgium. There are, perhaps, scattered over the rest of Europe, some dozen of these works yet; but their production does not materially add to the 4,475,000 cwts. of beet-root sugar annually produced by the works above named. It is evident that, in countries where labour is cheap, and whose inhabitants, but for the beet-root, would be dependent for their supply of sugar upon countries which possess colonies, or dependencies where sugar-cane can be grown, the cultivation of beet-roots intended for the manufacture of sugar is a decided boon. In some cases, objection may be raised to this industry, since it cannot be denied that the extensive culture of such crops as, for instance, beet-root, tobacco, madder, &c., may interfere, to some extent, with the cultivation of cereals. Yet, however cogent this objection (which has, also, been several times brought forward against the extensive cultivation of sugar-cane in hot climates), it is an undeniable fact that the rural populations in Europe derive great benefit from this industry, which keeps them suitably employed during the winter months of each year; and the results obtained fully prove that beet-root sugar can hold its ground, and compete successfully with colonial sugar when placed on equality therewith.

As regards the United Kingdom, it cannot but cause some astonishment, that a country ranking first in agriculture, and doubly so in everything relating to manufacturing industry, should have hitherto lagged behind in the successful carrying out of this industry—a fact the more to be wondered at since the cultivation of root crops is very extensively carried on, and the beet-root residues may serve as food for cattle even better than the roots purposely cultivated for that purpose. Agricultural labourers can (as instanced by Continental experience) be readily taught the operations of the beet-sugar manufacture; and the skilled supervision does not require more than, at the utmost, half-a-dozen men. In France, Belgium, and Germany, women, as well as men, are employed in these works. As to climate, excepting the central and northern parts of Scotland, and the high moor grounds, the United Kingdom is as favorably situated for the cultivation of beet-root for sugar manufacture as any portion of the European Continent; while the higher standard of agricultural efficiency in this country would greatly tend to secure good crops with existing system of rotation. As regards the duty on sugar, this is now equalised with that payable in the neighbouring countries—France, Belgium, and the Netherlands. So that, if this matter were to be properly taken up, and economically carried out, with due foresight, and there were brought to bear upon it that practical scientific knowledge which has raised, on the Continent, this industry from a puny infancy to the full strength of vigorous manhood, there is no doubt that it may become a source of great improvement and well-being to the rural population of this country.

ON THE

MANUFACTURE OF CRUCIBLE STEEL.

BY R. H. SMITH, F.C.S., ETC.

A great deal is being talked about the production of cast-steel directly from iron ores, or its manufacture from inferior kinds of English iron; but little is known or said (outside the immediate manufacturing districts) as to how the immense quantities of this substance are produced at the present time. The conversion of iron into steel is, perhaps, to be classed among one of the most peculiar, but, at the same time, interesting, processes with which chemists are acquainted.

The ordinary converting furnaces are of a conical shape, the bar-iron laying in stone pots, in contact with charcoal; and the heat to which the iron is exposed is regulated according to the purpose for which it may afterwards be required. The time generally occupied in what is termed "conversion" is about three weeks, a week being taken to raise the heat to a sufficient degree, a second to maintain it at the required temperature, and a third to gradually cool the furnace. When cold, the bars are withdrawn, and found to be covered with blisters, and, if broken, possessing a fracture totally different in appearance to that shown by the iron before treated in the manner described. Several tempers, as they are technically called, are produced in one furnace, and much care is necessary in selecting them out for the different requirements of the melter.

Too much care cannot be taken in the melting of steel, as the after work so much depends upon this part of the process. The melting holes are on a level with the floor of the furnace-room. Each hole has a flue; and some six, twelve, or more, of these form a flat stack. The grate bars at the bottom of each hole are approached by means of a cellar below. The crucibles, or pots, as they are called, made from a mixture of several kinds of clay and a little coke-dust, are formed into shape by means of a plug and flask. The pots are annealed over night, and, when at a dull-red heat in the morning, placed in the holes by means of tongs, each furnace taking two pots.

The bar-steel of the required hardness is now broken up, and the crucible charged by means of an iron funnel. The first heat, as it is called, will take from four to five hours before it is ready to be poured; but this greatly depends on the nature and hardness of the steel. The holes are watched and worked by the puller-out; but the word to draw the pot is given by the melter.

The puller out now lifts the crucible from the hole with large tongs, and places it upon the floor of the furnace. Its contents are then poured by the melter into a mould, made of cast iron in two pieces, covered with a coat of coal-tar soot, and held together by rings and wedges.

Great care is required in pouring, or teaming, the steel, as it is technically called, and skill in judging the proper heat when to cast it. Mild or soft steel should be teamed immediately the pot is withdrawn from the furnace; but hard steel may often remain a few minutes with advantage. Each crucible should last one day, and is used three times with charges of 50, 45, and 40 lbs. respectively.

All steel above a chisel temper contains 0·90 to 1·00 per cent of carbon. If well melted it will settle down in the mould, leaving a small hole at the top of the ingot. If, however, the molten steel has not remained long enough in the fire, it will pour fiery; and, if the ingot, on cooling, be broken, it will be found to be full of small holes, called honeycombs. Great precaution must also be used in not allowing the metal to remain too long in the fire, as hard steel, when of good quality, will soon scorch, and so render the ingot very brittle.

Well melted steel (say of a tool temper) may be thus known. The ingot will be of a blue colour, with a smooth and even skin; the fracture of uniform brightness, and the outer edge perhaps slightly scorched.

Another very important operation to which steel is subject is the hammering; and probably more good steel is spoiled in this department than any other. The ingot should be well soaked in the flame of the forge-furnace, and not at once (as is often the case) put into a dead fire—where the heat is what is called "dead," and where no flame surrounds the ingot.

The fineness of the fracture of a bar of finished steel greatly depends upon the heat that the bar is allowed to retain when the finishing stroke of the hammer is upon it. Coarseness and fineness of grain, as judging the temper or quality of cast-steel, is far over-estimated. It is, to a certain extent, an indication of hardness; but so much depends upon the way the bar has been finished, that it is of little practical value. However, best cast-steel, especially when hard, will show a fracture of a silky nature; and, when soft, will look bright, and shine like glass. Common cast-steel, on the other hand, will lack that brightness which is so characteristic of good steel; it will look dull, and have, so to speak, a leaden appearance about it.

In the working of steel, too much care cannot be bestowed; and, where (as in razor making) the workman is required to use a steel containing about 1·50 per cent of carbon, the durability of the razor will almost entirely depend upon the heat to which he subjects it while forging it into shape.

A useful "tool-steel" will contain about 1·2 to 1·35 per cent of carbon. Spindle-steel, or large size turning tools, will work well if containing about 1·15 per cent of carbon. Chisel-steel is a temper much used, will harden at a low heat, and possesses great toughness. Steel of 0·85 to 0·75 per cent of carbon will weld easily, and is adapted for "cold setts," or tools where the principal punishment is on the unhardened part.

In melting, charcoal is largely used when the bar-steel is not of the required hardness. Wolfram and titanium are occasionally used, but with little advantage.

Binoxide of manganese is universally employed. It forms a good flux, and protects the molten-steel from the action of the air.

Spiegeleisen is much used in Sheffield. It is an alloy of iron with manganese and carbon. The following is an analysis of a good spiegeleisen:—

Iron (by difference)	84·78
Manganese	10·21
Carbon	5·01
	100·00

Among the many irons employed in steel-making, none have acquired the reputation that those imported from Sweden have won for themselves, and especially those known as the Dannemora marks.

Such brands as Double Bullet (OO) and hoop L (L) command a high price, and are much used where the best quality steel is required. Second Swedes, such as Wand Crown, Steinbuck, Great S, K6, &c., are good bodied irons, largely employed, and making a very good steel. Of the commoner marks may be quoted (CW) (SV8) Spider, and $\overset{\frown}{\text{IG}}$; and where a high price cannot be obtained for the steel, such brands are recommended, being found to melt and work well. English irons and spring ends are also melted, but make an inferior quality of cast-steel.

The following is an analysis of tool-steel:—

Iron (by difference)	88·34
Carbon	1·31
Manganese	0·12
Silicon	0·19
Sulphur	0·03
Phosphorus	0·01
	100·00

ON THE

TESTING OF MANGANESE ORES.

BY BENJAMIN H. PAUL, PH.D.

The question raised by Sherer and Rumpf * as to the practice of representing the value of manganese ores by the amount of binoxide of manganese actually contained in them, or equivalent to the other peroxides of manganese which are sometimes present in such ores, is one that will, no doubt, attract the notice of chemical manufacturers. And the suggestion that the value of manganese ores should be measured by chlorometrical degrees, rather than by the actual percentage of binoxide, has a tendency in the same direction as the resolution † passed by the Association of Alkali Manufacturers, last year, in reference to this subject.

The decision then adopted by the Association would seem to have been based more upon differences found, in practice, to exist between working results and the indications of tests made for determining the percentage of manganese binoxide in sample, rather than upon any probable or ascertained cause of variation in the results obtained by the method of Fresenius and Will. It would seem, also, to indicate a desire on the part of manufacturers that tests of manganese ore should express the amount of binoxide *available* for liberating chlorine, and not the amount *actually* present in the ores. It is in this respect that the iron method has an advantage over the method of Fresenius and Will, since the presence of iron as metal or protoxide in manganese ore would affect its power of liberating chlorine. The result of a test of such manganese ore by the iron method would be correspondingly affected; but that would not be the case if the method of Fresenius and Will were adopted in the testing.

Much of the discrepancy between the results of tests of manganese ore, and many of the disputes that have arisen as to the percentage of these ores, may, in all probability, have been due to the circumstance mentioned above; and, to provide against a recurrence of such differences, it would seem desirable that, in regard to a certain class of manganese ores, some other mode of testing than that of Fresenius and Will should be agreed upon, so that the valuation of those ores may be based upon the available binoxide, and not upon the actual amount.

That form of the iron process in which chloride of iron is used does not appear to be suitable for this purpose, on account of the possible loss of chlorine which may take place in the operation; but Bunsen's method of dissolving the ore with hydrochloric acid, passing the liberated chlorine into iodide of potassium solution, and determining the iodine liberated, would probably answer the purpose.

However, there is reason to believe that Sherer and Rumpf have overlooked another circumstance which must be considered in regard to the method of Fresenius and Will. With certain limitations, there is little doubt that this method gives results which are uniform, especially if the manganese ore tested in that way is of German origin, or if it resembles the German ore in being soft and readily soluble; but many varieties of manganese ore now in use are not of that kind. The Spanish, Nova Scotian, and Californian ores, for instance, are often excessively hard, and, even when finely powdered, difficult to dissolve thoroughly. In testing such ores by the method of Fresenius and Will, there is, in the first place, a risk of incomplete solution, which would make the result too low. If heat be applied to the apparatus in order to render solution complete, there is, in the second place, a risk of driving off water, which would make the result too high.

In some instances, the differences that have obtained between the results of tests could not be referred to the presence of iron as metal or protoxide in the ores, inasmuch as Fresenius and Will's method has, in those cases, been used by the several operators, and it is probable that those differences arose from the difficult solubility of the ore. But, however that may be, it seems no longer admissible to use that method for testing manganese ores generally, although there is no reason to doubt the uniformity of its results when applied to the soft kind of ores formerly in use almost exclusively.

For these reasons, and on account of the long time requisite for dissolving manganese ores of this kind, the method of Fresenius and Will is not well adapted for testing them. For some time past, therefore, I have adopted Mohr's method of using a known quantity of a standard solution of oxalic acid, together with excess of sulphuric acid, for dissolving the ore; if necessary boiling until the ore is completely dissolved, and then, by means of a standard solution of permanganate, determining the quantity of oxalic acid remaining undecomposed. This method is very convenient for testing manganese ores, and since it involves only one weighing for each test, the source of error is less than in the method of Fresenius and Will. The results obtained are also very uniform.

This method has also the advantage of giving results which fairly represent the amount of available binoxide in manganese ores; for any iron that may be present as metal or protoxide would consume an equivalent quantity of permanganate solution, and thus apparently reduce the quantity of oxalic acid decomposed by the binoxide to an extent proportionate to the amount of iron existing in the ore. Thus, for instance, if the quantity of oxalic acid decomposed by 100 grains of manganese ore free from iron or protoxide of iron were 109·53 grains, the ore would contain 76·5 per cent binoxide, and the whole of that would be available. But, if the 100 grains of ore also contained 5·6 grains of metallic iron, or an equivalent of protoxide, the permanganate solution required for peroxidising that iron would represent 6·3 grains of oxalic acid, and the quantity of oxalic acid decomposed by the binoxide would appear so much less than it really was, or 103·23 grains instead of 109·53 grains. Accordingly, the amount of binoxide would be repre-

* Chemical News, vol. xx., p. 302; *Am. Rep. Feb. 1870, page 82.*
† "That, as the testing of manganese according to the method of Will and Fresenius is, in the opinion of the meeting, incorrect, and yields uncertain results, it is recommended to members of this Association not to buy by that test."

sented as 72·1 per cent, instead of 76·5 per cent; and that would, in fact, be the amount of binoxide available for generating chlorine.

This method of testing recommends itself by its simplicity, and by the fact that the standard solutions of oxalic acid and permanganate will keep for a long time without alteration of value.

The oxalic acid solution contains 63 grms. in the litre, and 1 c.c. is equivalent to 5 c.c. of the permanganate solution.

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ON THE

SIMULTANEOUS OCCURRENCE OF A SOLUBLE LEAD SALT

AND

FREE SULPHURIC ACID IN SHERRY WINE;

WITH OBSERVATIONS ON THE SOLVENT ACTION OF ALCOHOLIC SALINE SOLUTIONS UPON SULPHATE OF LEAD.*

BY PROFESSOR F. H. STORER.

Several years since, I was called upon by a wine merchant of this city to examine a sample of pale sherry taken from a cask which had been returned to him, on the certificate of a chemist that the wine contained lead. The sample in question was perfectly transparent and clear. There was nothing in the appearance or taste of the wine to indicate the sophistication to which it had really been subjected.

On submitting this sherry to chemical analysis, I found not only that it held in solution a considerable proportion of lead, but also a decided trace of free sulphuric acid, besides an abundance of the same acid combined with some alkaline base. When a portion of the wine was evaporated in contact with slips of paper, the latter soon became crumbly and friable.

Regarded merely from the chemical point of view, without reference to its manifest bearing upon questions of hygiene and jurisprudence, the simultaneous occurrence of a lead salt and of free sulphuric acid in alcoholic solution is a fact sufficiently important to merit close attention. Unfortunately, the small sample of wine given me was completely exhausted in the severe confirmatory tests by which the results above mentioned were controlled, and I have had no opportunity to determine the precise manner in which the lead was held in solution in that particular case. Several conjectures as to the cause of the phenomenon will be discussed below.

That lead compounds should still be employed in the treatment of wine will surprise no one familiar with the tenacity with which traditions are held by successive generations of operatives in many of the chemical arts. According to Taylor,† "litharge was formerly much used to remove the acidity of sour wine and convey a sweet taste. Acetate of lead, or some other vegetable salt of the metal, is in these cases formed; and the use of such wine may be productive of alarming symptoms. Many years since a fatal epidemic colic prevailed in Paris owing to this cause; . . . . the adulteration was discovered by Fourcroy, and was immediately suppressed."

Beckmann in his "History of Inventions"‡ dwells at some length on the antiquity and enduring character of the practice of neutralising the acid which spoils wine by means of litharge. According to this author, the practice was forbidden by legal enactment in France as early as 1696, but a hundred years later "the art of improving wine by litharge was taught in England as a method perfectly free from danger." *

The sulphuric acid in the sample of wine examined by me was probably added, with a view of removing the dissolved lead resulting from the previous use of litharge. It is not unlikely that the addition of the free acid was preceded by that of a solution of sulphate of ammonium.

In seeking for an explanation of the fact that a certain proportion of lead may remain dissolved in wine, even in presence of free sulphuric acid, the following hypotheses suggest themselves:—

1st. It seemed not impossible, in case a mixture of weak alcohol, dilute sulphuric acid, and sulphate of lead was left to itself for a long time, that a part of the lead salt might be changed to sulphovinate of lead and pass into solution. This idea was sufficiently improbable in view of the known facts that dilute alcohol and weak sulphuric acid are unfit for making sulphovinic acid, and that but little, if any, of the acid can be formed even from tolerably concentrated liquids, unless the mixture of alcohol and sulphuric acid be heated artificially. The idea was, nevertheless, put to the test of experiment, as follows:—

100 c.c. of alcohol of 59 per cent, 5 c.c. of oil of vitriol, and a quantity of recently precipitated sulphate of lead were placed in a stoppered bottle, and the mixture was frequently shaken during an interval of three months. The clear liquid was then decanted, diluted with water, and saturated with sulphuretted hydrogen gas. Not the slightest colouration indicative of lead was produced.

100 c.c. of similar alcohol, mixed with sulphuric acid, sulphovinic acid, and sulphate of lead, gave no reaction for lead when tested after the lapse of three months.

2nd. Though the idea seemed highly improbable, it was still possible that the sugar in the wine might in some way exert a solvent action upon sulphate of lead. It was found, however, when 100 c.c. of alcohol of 59 per cent and 5 c.c. of oil of vitriol, together with a quantity of sugar and of precipitated sulphate of lead, were left to themselves for three months, that the clear supernatant liquid held no trace of lead in solution. For that matter, it was found that a mixture of sulphuric acid and much sugar-water was capable of precipitating all the lead even from an aqueous solution of acetate of lead. The filtrate from the sulphate of lead thus precipitated gave absolutely no indication of lead when tested with sulphuretted hydrogen, not even when a considerable quantity of the liquid was evaporated to dryness, incinerated, treated with nitric acid, and again evaporated before applying the reagent.

3rd. The most probable hypothesis of all, however, was, that a certain proportion of lead could be held dissolved in presence of sulphuric acid, even in an alcoholic solution like wine, by the action of various soluble alkaline salts capable of decomposing and of being decomposed by sulphate of lead; for it is a well-known fact that very considerable quantities of sulphate of lead can be held dissolved in water by means of many acetates, citrates, and tartrates, and by various other salts.

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* Communicated by the Author.
† "On Poisons," p. 502 of the London edition.
‡ "Chapter on Adulteration of Wine."

* William Graham's "Art of Making Wines from Fruit, Flowers, and Herbs." London, sixth edition.

To test this idea, the following set of experiments has been carried out at my suggestion by Mr. A. H. Pearson, of Haverhill, a student in the Laboratory of the Massachusetts Institute of Technology.

A considerable quantity of dilute alcohol, of the usual strength of sherry wine (18 per cent), having been prepared, standard solutions of acetate of lead, of sulphuric acid, and of sulphate of ammonium were made by dissolving weighed quantities of these substances in portions of the 18 per cent alcohol. Each of the solutions was made of such strength that 500 c.c. of the liquid contained one-tenth of an equivalent of the salt or acid, reckoned in grammes, on the hydrogen scale.

Alcoholic solutions of several salts of ammonium and of the fixed alkalies were also prepared, as will be described below.

In each experiment, equal quantities of the standard solution of sulphuric acid, or of sulphate of ammonium, and of the saline solution to be tested were mixed in a glass flask, and the standard solution of acetate of lead was made to fall from a burette drop by drop into the mixture until a persistent precipitate of sulphate of lead was perceived. The burette was graduated so that two drops from it were equal to one-tenth of a cubic centimetre; and the flask was constantly shaken while the drops of acetate of lead were falling into it.

The results of the experiments are as follows:—

Acetate of Ammonium was prepared by neutralising ordinary acetic acid with ammonia-water, and the strong aqueous solution thus obtained was mixed with alcohol. It appeared, however, that this alcoholic solution of the acetate exerted no solvent action upon sulphate of lead, for a permanent precipitate of the latter was produced in the mixture of acetate of ammonium and normal sulphuric acid by the first drop of the standard solution of acetate of lead. The same negative result was obtained in several repetitions of the experiment, even when new portions of dilute alcohol and a second set of the standard solutions were employed.

When, however, the solution of acetate of ammonium was mixed with an equal bulk (10 c.c.) of the standard solution of sulphate of ammonium, instead of the sulphuric acid, a considerable quantity of sulphate of lead was held in solution by it. In two distinct trials, the precipitate formed by dropping acetate of lead into the mixed solution of acetate and sulphate of ammonium, continued to re-dissolve until 3 c.c. of the standard solution of acetate of lead had been added to the liquor. These 3 c.c. of the standard solution contained 0·1137 grm. of acetate of lead, corresponding to 0·0909 grm. of sulphate of lead. To hold dissolved 1 part of sulphate of lead in the dilute alcohol charged with sulphate of ammonium, there was consequently require l 110 c.c. of a tolerably strong solution of acetate of ammonium.

Still another experiment with sulphuric acid was made, by mixing 10 c.c. of an entirely new preparation of acetate of ammonium with a similar quantity of the standard solution of acetate of lead, and dropping the standard sulphuric acid into the mixture. No persistent precipitate was produced in this case until 5 c.c. of the acid had been added. This quantity of the standard acid contained 0·049 grm. of sulphuric acid, corresponding to 0·1515 grm. of sulphate of lead; hence only 33 parts of the solution of acetate of ammonium were required to dissolve 1 part of sulphate of lead. It is to be observed that the insolubility of tartrate, citrate, and succinate of lead in alcohol prevents the application of this modified form of the experiment in the examples given below. With the exception of the acetates of ammonium and sodium, none of the salts experimented with can be mixed with the acetate of lead and subsequently tested with sulphuric acid or sulphate of ammonium.

Acetate of Sodium, whether mixed with the normal sulphuric acid, with sulphate of ammonium, or with acetate of lead, seemed to have no solvent action upon sulphate of lead.

Neither *Oxalate of Ammonium* nor normal *Oxalate of Potassium* exerted any solvent action, either in presence of the sulphuric acid or the sulphate of ammonium.

Tartrate of Ammonium.—Normal, crystallised tartrate of ammonium was dissolved in alcohol of 18 per cent, in such proportions that 500 c.c. of the solution contained 1-10th of an equivalent, 18·4 grms. of the salt. Twenty-five c.c. of the solution were mixed with an equal volume of the normal sulphuric acid; and normal acetate of lead was added to the mixture until a permanent precipitate was produced. To effect this result, there was required of the standard solution of acetate of lead 2 c.c., or 0·0758 grm. of the acetate, corresponding to 0·0606 grm. of sulphate of lead. The 25 c.c. of the solution of tartrate of ammonium contained 0·92 grm. of the dry salt. Hence, something more than 15 parts of tartrate of ammonium are required to hold 1 part of sulphate of lead dissolved in diluted alcohol containing free sulphuric acid.

In two other experiments, where the tartrate of ammonium solution was mixed with the sulphate of ammonium, instead of with free sulphuric acid, 3 c.c. of the acetate of lead solution had to be added before a permanent precipitate could be formed.

That sulphuric acid is a more efficient precipitant o lead in presence of tartaric acid than sulphate of ammonium was shown in another way. Thirty c.c. of the standard alcoholic acetate of lead were mixed with an equal volume of the standard solution of tartrate of ammonium. The precipitated tartrate of lead was filtered, and the filtrate mixed with a quantity of the sulphate of ammonium solution. No precipitate was produced, though, on the subsequent addition of sulphuretted hydrogen, a slight precipitate of sulphide of lead was formed. In a similar experiment, where sulphuric acid was substituted for sulphate of ammonium, a slight precipitate was produced by the sulphuric acid, and no precipitate could be obtained afterwards with sulphuretted hydrogen.

In two other experiments, where 5 c.c. of the acetate of lead solution were mixed with 30 c.c. of the tartrate of ammonium, no precipitate was produced by sulphate of ammonium in the filtrate from the tartrate of lead, while sulphuric acid gave a slight precipitate as before. In this case, however, sulphuretted hydrogen gave a slight precipitate after sulphuric acid as well as after sulphate of ammonium.

Normal *Tartrate of Potassium*, mixed with the solution of sulphuric acid, exerted no solvent action on sulphate of lead.

Succinate of Ammonium, prepared by neutralising a solution of succinic acid with ammonia-water, exerted no solvent action when mixed with the free sulphuric acid; but, when mixed with the solution of sulphate of ammonium, 6 c.c. of the acetate of lead solution were added to the liquor before a permanent precipitate fell.

Normal *Citrate of Ammonium* was prepared by neu-

tralising a weighed equivalent portion of crystallised citric acid with ammonia-water. Ten c.c. of the solution were mixed with an equal volume of the standard sulphuric acid, and the standard solution of acetate of lead was dropped into the mixture in the usual way. No permanent precipitate was formed until 16 c.c. of the lead solution had been added. These 16 c.c. contained 0·6664 grm. of acetate of lead, corresponding to 0·4848 grm. of sulphate of lead. The 10 c.c. of citrate of ammonium solution contained 0·42 grm. of crystallised citric acid. Hence, 1 part of sulphate of lead was held dissolved in the mixture of alcohol and dilute sulphuric acid for every 0·8663 part of citric acid in the liquor.

On repeating the experiment, a precisely similar result was obtained: 16 c.c. of the standard lead solution had to be added to the mixture of alcohol and sulphuric acid before the precipitate ceased to re-dissolve as fast as it formed.

In two other experiments, where, instead of free sulphuric acid, 10 c.c. of the standard solution of sulphate of ammonium were mixed with 10 c.c. of the citrate of ammonium solution, 30 c.c. of the standard lead solution had to be added in each case before any permanent precipitate formed.

Dicitrate of Ammonium $C_{12}H_5(NH_4)_2O_{11}$, was prepared in crystals, and 22·6 grms. of the salt were dissolved in 500 c.c. of the 18 per cent alcohol. Twenty-five c.c. of the solution were mixed with an equal volume of the standard sulphuric acid, and the acetate of lead solution was dropped into the mixture in the usual way. After the addition of 8 c.c. of the standard acetate of lead, a permanent precipitate was produced. These 8 c.c. contained 0·3032 grm. of acetate of lead, corresponding to 0·2424 grm. of sulphate of lead. The 25 c.c. of dicitrate of ammonium solution contained 1·13 grms of the dry salt. Hence, 1 part of sulphate lead was held dissolved for every 4·6617 parts of the dicitrate.

Tricitrate of Potassium.—Twenty-five c.c. of a standard solution of ordinary crystallised citrate of potassium, mixed with an equal volume of the standard sulphuric acid, gave no permanent precipitate until 2 c.c. of the solution of acetate of lead had been added to it.

Sugar.—A standard solution of cane-sugar, mixed with an equal volume of the sulphuric acid, gave a permanent precipitate on the addition of the first drop of the acetate of lead.

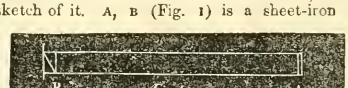
These experiments show clearly that very considerable quantities of sulphate of lead can be held in solution by weak alcohol charged with various salts. It may, therefore, reasonably be inferred that wines sometimes retain lead in solution, in consequence of this action of the acids and salts peculiar to wine upon lead compounds ignorantly employed to correct acidity.

NOTE ON THE

SUPPOSED POLARISATION OF THE CORONA.*

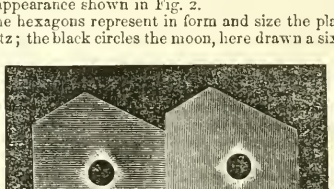
BY PROF. E. C. PICKERING.

An observation on this subject is given in my report in the Chemical News (vol. xx., p. 222; *Am. Repr., Jan.* 1870, *page* 14), but as the form of the instrument used has been in one or two cases misunderstood, I enclose a sketch of it. A, B (Fig. 1) is a sheet-iron tube,



closed at A with a plate of quartz, and at B with a prism of Rochon. The latter has the property of giving two images of any object seen through it, separated by an angle of nearly 3°. Looking through the tube we therefore see two images of the quartz touching, but not overlapping. When the light is polarised, these images assume complementary tints, which vary with the plane of polarisation and the thickness of the quartz. On turning this instrument towards the sun during totality, the images presented the appearance shown in Fig. 2.

The hexagons represent in form and size the plate of quartz; the black circles the moon, here drawn a sixth of



an inch in diameter, as the scale is about 3° to the inch The corona appeared white, but the sky surrounding it was coloured in one image blue, in the other yellow,—represented in the figure by vertical and horizontal lines. The conclusion to be drawn from this is, that the light of the corona is unpolarised, or, more strictly, that the amount of polarised light, if any, is too slight to be perceptible with this instrument. Its delicacy, although not equal to Savart's polariscope, is very great, giving coloured images with paper, wood, and other bodies which reflect a small amount of light specularly. The day before the eclipse it showed, in a very marked manner, the polarisation of the wet pavements and roofs. To measure its sensitiveness, I viewed the light reflected by a piece of plate glass, at different angles of incidence, and found that the colour ceased to be visible when this angle was about 10°, which, allowing for the reflection from the second face, would give about one part of polarised to twenty-four of natural light.

Observers heretofore have generally attached their polariscope to a telescope, and thus introduced a source of error, avoided in my instrument. For light passing through the object-glass and field lens would be polarised before reaching the polariscope by the obliquity of the incidence, caused both by the curvature of the surfaces and the fact that the edge of the field of view receives its light not parallel to the axis. The plane of polarisation would be perpendicular to a plane falling through the axis of the instrument. Now, if any part of the corona was brought into the centre of the field of view, the adjoining portions would appear polarised in planes parallel to the edge of the field, or passing through the sun's centre. In sweeping around the sun's edge, the plane of polarisation would continually

* Communicated by Prof. Morton, Editor of the *Journal of the Franklin Institute*, to whom we are indebted for copies of the woodcuts.

change, as the corona passed through different parts of the field, and the comparative darkness of the moon's disk and the exterior sky prevent the polarisation of the other portions of the field from being visible. The degree of polarisation by refraction would be very slight and perhaps imperceptible, but the agreement of observation with this hypothesis is certainly a curious coincidence.

The strongest argument against the polarisation of the corona is furnished by the spectroscope, the presence of bright lines and absence of dark ones, as observed by Prof. Young, denoting incandescence, a view strengthened by the consideration that each square centimetre of the surface of the corona would receive several thousand units of heat per minute. I am well aware that my results are at variance with those obtained by previous observers, including some of the most eminent astronomers of the day, but as far as I can learn this form of polariscope has not been used for the purpose, and therefore hope that my experiment may be repeated during the next eclipse.

ON ESSENCE OF SASSAFRAS.

BY MM. E. GRIMAUX AND Y. RUOTHE.

Essence of *Laurus sassafras* is colourless when first rectified, but turns gradually yellow after exposure to air and light. Its smell resembles that of essence of fennel. Its density at zero is 1·0815; it rotates the polarised ray to the right, and its rotatory power is 3·5 for a length of 10 centimetres. It is a mixture of dextrogyrous hydrocarbon with an inactive oxygenated principle, and also contains small quantities of a body which is apparently a phenol, and which gives it the power of reducing nitrate of silver. This body is separated from the essence by stirring with this latter an aqueous solution of potash, which, after the addition of chlorhydric acid, precipitates some oily drops, having a strong smell of eugenic acid, and coloured light green by ferric chloride. By distilling this body with steam, a colourless liquid was obtained in just sufficient quantity to permit analysis, which gave C = 74·43, H = 6·46. Such extremely small proportions are found in the essence that it can scarcely be said to do more than exist. The hydrocarbide (safrène) contains $C_{10}H_{16}$, which formula is confirmed by the density of its vapour, which, ascertained by Dumas's method, was found equal to 4·71 (theoretically, 4·7). Safrène boils between 155° and 157°, is dextrogyrous, and its rotatory power is 17°·5 for a length of 10 c.c.; its density at zero is 0·8345.

Nine-tenths of the essence are extracted after the first distillation between 230° and 236°. They consist of an oxygenated principle (safrol), which distils chiefly between 231° and 233°. This latter has not a constant boiling point, for it always changes and becomes slightly resinous under the influence of much heat. It is insoluble in water, but difficult to dry over chloride of calcium, and requires rectification in a current of pure hydrogen before analysis. Its odour is similar to that of the essence; its density 1·1141 at zero; it exerts no influence on polarised light, and remains liquid at a cold as low as −20°. Safrol will not combine with bisulphites, dissolve sodium, or decompose chloride of benzoyle at its boiling point. It will not dissolve alcoholic potash even at 180°, but is changed by it into a black, non-crystallisable resin.

Treated with boiling iodhydric acid at 127°, it yields a thick green iodised oil; with perchloride of phosphorus it gives only a protochloride, and no trace of oxychloride, and the thick viscous body left in the retort after distilling the protochloride should be a monochloruretted safrol. It does, in fact, present the appearance and qualities of those monobromised derivatives obtained by merely adding a molecule of bromine to a molecule of safrol, but if excess of bromine be added, a solid crystallised derivative of pentabromised safrol, $C_{10}H_5Br_4O_2$, is obtained. To prepare this body, dissolve safrol in sulphide of carbon, and add five times its weight of bromide; after a few days the vessel will be found to contain crystals. Dissolve these in chloroform, wash the solution with potash, and concentrate; rectangular and perfectly white flakes of pentabromised safrol, $C_{10}H_5Br_5O_2$, will separate.

This body melts at 169° or 170°, is but slightly soluble in alcohol or ether, even at the boiling point, and dissolves in about fifteen times its weight of chloroform, with simultaneous production of a very small quantity of another bromised derivative melting at 109°. Upon subjecting safrol to the action of sundry other reagents, no satisfactory results were obtained. Nitric acid, even when much diluted, renders it resinous, with production of oxalic acid; it dissolves in the fuming acid, yielding a non-crystallisable derivative, soluble in alkalies at moderate temperature. When heated with chloride of zinc or phosphoric anhydride, it quickly decomposes, leaving much carbon; sulphuric acid produces the same effect. Fusing potash attacks it with difficulty; a distillation of the essence over melting potash modifies its boiling point; that which formerly distilled between 230° or 234°, now comes over between 245° and 250°, and even at from 247° to 248°. The analysis of this body gives the same figures as that of the essence.

ON THE

METHODS OF ANALYSIS

AND THE

COMPOSITION OF VARIOUS CHEMICAL MANUFACTURING PRODUCTS.

BY M. GASTON TISSANDIER.

(Continued from Am. Repr., Jan. 1870, page 4.)

Animal Black.

The consumption of animal black in sugar factories is very considerable; and this product now plays a prominent part in commerce. After having been used in the clarifying of sugar, animal black is sometimes employed in agriculture; but on this point we shall examine it more particularly in speaking of manures.

Ash.—The sample to be analysed is ground and sifted; 2 grms. are taken and calcined in a platinum crucible till the perfectly white residue contains no further traces of carbon. This residue, when weighed, gives the proportion of ash contained in 2 grms. of material. The carbon and moisture are given by difference. Care must be taken to moderate the heat in this calcination, so as not to decompose the carbonate of lime contained in the ash.

Carbon.—5 grms. of animal black are dried at 110° in a stove, or in a paraffin-bath; the loss of weight gives the moisture, which, subtracted from the loss by calcination, furnishes the proportion of carbon.

Silica.—The ash obtained by the calcination of animal black is dissolved in water acidulated with chlor

hydric acid; it is slightly heated, and the insoluble siliceous remainder is filtered and weighed.

Phosphate of Lime.—To the filtered solution is added a slight excess of ammonia, which precipitates all the phosphate of lime ($PO_5,3CaO$); it is filtered, and the precipitate is dried, calcined, and weighed.

Carbonate of Lime.—The liquid, separated by filtration from the phosphate of lime, contains carbonate of lime, which is precipitated at the boiling point by oxalate of ammonia. The precipitate of oxalate of lime is collected; this it is well to filter and wash by decantation, pouring the washing-water on the filter. The calcination of this precipitate necessitates, as is well-known, some precautions. The oxalate of lime must be heated to a sufficient temperature (approaching red-heat), to transform it into carbonate of lime; but the heat must not be so great as to decompose the residue of carbonate of lime. After having weighed the carbonate of lime, the operation may be controlled in the following manner:—The precipitate is moistened with sulphuric acid; it is calcined, in order to get rid of the excess of this acid, and the sulphate of lime obtained is weighed. This amount ought to correspond with the quantity of carbonate of lime, if the operation has been properly executed. Animal black contains traces of magnesia, which can be estimated in the form of ammonico-magnesian phosphate.

Soluble Salts.—50 grms. of animal black are weighed and thrown into a little stoppered flask containing about 50 c.c. of distilled water; this is well shaken for a few minutes, and then filtered. The insoluble residue is redigested in a fresh quantity of water; and this is repeated several times, so as to eliminate the whole of the soluble salts. The filtered liquid is evaporated over the sand-bath in a little porcelain capsule; the dry residue is weighed, and its weight gives the proportion of soluble salts. These salts consist of alkaline chlorides, sulphates, and carbonates; they also contain traces of sulphate of lime and sulphide of calcium.

Composition of Animal Black used in Sugar Refining.

Substances Estimated.	I.	II.	III.	
Water	2·00	1·37	1·21	Loss on calcination.
Carbon	8·42	9·90	11·12	
Carbonate of lime	14·92	13·80	12·22	Ash.
Phosphate of lime	72·50	72·25	74·43	
Silica	1·80	2·50	0·40	
Soluble salts	0·36	0·18	0·62	
Total	100·00	100·00	100·00	

Decolourising Power.—We have devised a method which enables us to compare the decolourising power of an animal black with that of another black of good quality, taken as a standard, and to represent the relation of the two decolourising powers by an exact number.

10 grms. of the standard black, and 10 of the black under assay, are weighed; the two samples, finely pounded, are placed separately on two filters of the same size.

A solution of caramel in water is prepared, so as to produce a rather dark colour, somewhat like that of weak tea. The first standard black is moistened with 20 c.c. of this solution, which runs through colourless; 20 more c.c. are passed through, and so on till the liquor passes coloured. When it presents just the same shade as the unfiltered solution of caramel, the operation is stopped.

The same experiment is made with the black under assay, placed on the second filter, and the quantity of solution required to be passed through until it is of the same colour noticed, as in the preceding experiment. Let us suppose that the standard black decolourised eight pipettes full of the caramel solution, and the black under assay only four: we say that the decolourising power of the latter is equal to one-half, relative to that of the former.

A solution of caramel may be kept ready prepared, so as to serve as a testing liquid.

Acetic Acid.

Acetic acid, sometimes called, in commerce, pyroligneous acid, generally contains about 40 per cent. of acetic acid, $C_4H_4O_4$; it is sold by the acidimetric standard, which is determined by means of a titrated alkaline liquid.

Acidimetric Standard.—Preparation of the Alkaline Liquid.—We have already shown how the alkalimetric sulphuric acid may be prepared accurately; this well-verified solution, containing 100 grms. of sulphuric acid per litre, is the basis of the preparation of the alkalimetric liquid which, in laboratories, is used to effect nitrogen determinations or to take acidimetric standards.

Any quantity whatever of pure caustic soda—15 or 18 grms., for instance—is dissolved in a litre of water. 10 centimetres of the normal sulphuric acid liquor (containing 1 grm. of SO_3HO) are taken and poured into a small precipitating glass; to this is added some sensitive tincture of litmus, and the solution of caustic soda poured into it drop by drop by means of a graduated burette, divided into tenths of c.c., till the red litmus becomes blue—that is to say, till the acid is saturated. Let us suppose that 50 c.c., or 500 divisions, of our alkaline solutions are required to saturate 10 c.c. of the titrated sulphuric acid liquid. We know that 500 divisions saturate 1 grm. of sulphuric acid, and we can calculate, according to the equivalents, what quantity of acetic acid will saturate a certain volume of our liquid; we know, for example, that 500 divisions ought to saturate 1·224 grms. of acetic acid, $C_4H_4O_4$:—in fact,

$$\frac{49(SO_3,HO)}{60(C_4H_4O_4)} = \frac{1.}{x}$$

Before thus standardising the alkaline liquor of caustic soda, it is well to add some slaked lime, to prevent it from carbonating, which would interfere with the sharpness of the colouration of the red litmus into blue. Before using this liquor, the bottle which contains it is shaken, and left to settle, so that the lime may be deposited at the bottom; the solution, becoming clear in a few minutes, is then poured into the graduated burette, which is used to take the standard of pyroligneous acid under assay.

According to arrangement between the buyer and seller, the standard of this acid is taken either by *volume* or by *weight*. In the former case, 1 c.c. of acetic acid is saturated, in the latter 1 grm.

In order to take the standard by weight, a small glass, containing in it a 10-grm. weight, is tared on a sensitive balance. Equilibrium being established, the 10-grm. weight is taken out, and the acetic acid to be tested is then gradually poured into the glass by means of a small tube, so as to regain the equilibrium. We have thus, by double weighing, obtained 10 grms. of acetic acid, which are to be diluted with water so as to give a volume of 100 c.c.

After this solution has been rendered homogeneous by shaking, 10 centimetres of it are removed, corresponding to 1 grm. of acetic acid. Instead of directly weighing 1 grm. of the acid to be tested, it is better to weigh 10 grms. of it, as we have indicated; because, in case of a verification being needed, it is easier to measure 10 c.c. than to commence a fresh weighing.

The 10 centimetres deducted are placed in a precipitating jar, litmus is added, and the alkaline soda liquid poured in, drop by drop, till the litmus becomes clearly blue. If 150 divisions have been used, we shall obtain the acidimetric standard of pyroligneous acid by the following equation:—

500 divisions saturate..... 1·224 grs. of $C_4H_4O_4$
150 " will saturate.... x.

whence—

$$x = 0{\cdot}3672.$$

100 grms. of the assayed acetic acid contain, then, 36·72 grms. of $C_4H_4O_4$, which is expressed by saying that its standard is 36·72°.

When the standard is taken by volume, the operation is the same; only, instead of weighing 10 grms. of the acid, 10 c.c. are measured.

Examination for Mineral Acids.—Acetic acids are sometimes adulterated with mineral acids (chlorhydric and sulphuric, &c.), which augment their standard.

To detect their presence, 50 c.c. of acetic acid are heated to the boiling point with 1 or 2 centigrms. of starch, and left to boil about twenty minutes. When the liquid has become cold, some drops of tincture of iodine are poured into it. If a blue colouration of iodide of starch occurs, the acetic acid contains no mineral acids; but if this colouration is not produced, we may be certain of the presence of mineral acids, which, under the action of heat, have transformed the starch into dextrine, and thus prevented the formation of the iodide. Care must be taken to pour the iodine into the cold liquid, for iodide of starch is decolourized spontaneously under the action of heat. Chlorhydric acid may also be immediately detected, by adding to the acetic acid a few drops of nitrate of silver; and the presence of sulphuric acid is discovered by chloride of barium. In the latter case, it must not be forgotten that chloride of barium is insoluble in acids, and that the acetic acid ought to be diluted with a sufficiently large quantity of water to avoid the possibility of error from this cause.

Pyroligneous acids generally standardise 39° to 40°; however, this figure is not absolute. We have sometimes met with samples containing only 34 per cent of acetic acid, others having 46 to 50 per cent, and even still larger quantities.

(To be continued).

ON THE

METHOD OF ANALYSING SILICATES THAT DO NOT GELATINISE WITH HYDROGEN CHLORIDE.*

BY NEVIL STORY-MASKELYNE, M.A.,

PROFESSOR OF MINERALOGY IN THE UNIVERSITY OF OXFORD, AND KEEPER OF THE MINERAL DEPARTMENT, BRITISH MUSEUM.

The process is conducted in an apparatus of the following constructions:—A platinum retort, 30 c.c. in capacity, is fitted with a tubulated stopper of the same material, which reaches nearly to the bottom; a small tube, entering the vertical tube of the stopper at an angle above the neck of the retort, conveys hydrogen to its interior. The vertical tube can be closed, either by a stopper of platinum, or by a funnel of that metal, stopped in like manner at the top, and having a fine orifice at its lower extremity.

To the side of the retort, just below its neck, a straight delivery tube is fixed, which in its turn fits into another platinum tube that, after taking a curve into a vertical position, is enlarged into a cylinder, which passes a considerable distance down a test-tube. The latter, into which the delivery tube is fitted with a cork, holds 7·5 c.c., or 6·6 grms. of strong ammonia of the sp. gr. 0·88.

The gas delivery tube inserted in the side of this receiver dips into some more ammonia in a second test-tube.

The pounded mineral, from 0·2 to 0·5 grm. in quantity, and a small platinum ball, are placed in the retort, and the stopper luted to it with gutta-percha, and cemented air-tight in its place with caoutchouc and gutta-percha varnish. The funnel, filled with perfectly pure hydrogen fluoride, is now introduced into the tubulure of the stopper, the tap opened, and the acid allowed to run down into the retort. This acid contains about 32 per cent of absolute hydrogen fluoride—that is to say, a funnel of this reagent contains 1·12 grms. of acid, capable of rendering gaseous 0·84 gm. of silica, and of neutralising 0·95 grm. of ammonia. The funnel is now replaced by a little platinum stopper, and the orifice secured air-tight with gutta-percha varnish. Pure hydrogen is then allowed slowly to traverse the entire apparatus; the retort is placed in a water-bath at 100° C. for two hours, and occasionally slightly shaken to set the ball rotating. During the operation, a trace only of silicium difluoride passes over.

The retort is next transferred to a paraffin bath, and the temperature is cautiously raised. At first, hydrogen fluoride passes over, and at this point of the process the flow of hydrogen requires some attention to prevent regurgitation of the ammonia. At about 132° C., in the case of the silicates mentioned in this memoir, the silica first becomes visible in fine flocks in the ammonia of the receiver, and in another minute the whole is cloudy.

In eight minutes, the rise of the thermometer to 145° C. has brought over so much difluoride that the contents of the tube are semi-solid, and nearly the whole of it has passed over. The temperature is then raised to 150° C., and the retort allowed to cool. The process is next repeated with a fresh charge of acid and ammonia. If no more than 0·2 grm. of silicate be taken, twice charging of the retort is sufficient; but with 0·5 grm. three or four repetitions of the process are required. In short, the operation is continued with fresh reagents till no flock of silica forms in the receiver. Finally, 0·75 c.c. of sulphuric acid is introduced into the retort, and the temperature again raised to 160° C., the stream of hydrogen being continued as before.

The several ammoniacal charges are poured into a platinum dish, together with the washings of the delivery tube, and the two test-tubes, and slowly evaporated in a water-bath with continued stirring.

At a point in the evaporation just before the solution becomes neutral, and the ammonium fluoride begins to turn acid, the entire silica in the dish will have been

* Extracted from a paper "On the Mineral Constituents of Meteorites," communicated to the Royal Society.

dissolved by the fluoride. The process is gradual, but the moment when the solution is complete is easily determined. Then, the dish being removed, potassic chloride is added in slight excess, together with absolute alchohol equal in volume to the contents of the platinum vessel. Potassium fluosilicate precipitates, which, after the lapse of twenty-four hours, is filtered, weighed with a mixture of equal volumes of absolute alcohol and water, dried, and washed. The results are accurate. In the retort are the bases in the form of sulphates, the treatment of which calls for no further remark.

ON FLUORIDE OF SILVER.*

BY GEORGE GORE, F.R.S.

This communication treats of the formation, preparation, analysis, composition, common physical properties, and chemical behaviour of fluoride of silver.

The salt was prepared by treating pure silver carbonate with an excess of pure aqueous hydrofluoric acid, in a platinum dish, and evaporating to dryness, with certain precautions. The salt thus obtained invariably contains a small amount of free metallic silver, and generally, also, traces of water and of hydrofluoric acid, unless special precautions mentioned are observed. It was analysed by various methods. The best method of determining the amount of fluorine in it consisted in evaporating to dryness a mixture of a known weight of the salt, dissolved in water with a slight excess of pure and perfectly caustic lime in a platinum bottle, and gently igniting the residue at an incipient red heat until it ceased to lose weight. By taking proper care, the results obtained are accurate. The reaction in this method of analysis takes place according to the following equation:—

$$2AgF+CaO=CaF_2+2Ag+O.$$

Sixteen parts of oxygen expelled equal 38 parts of fluorine present. One of the methods employed for determining the amount of silver consisted in passing dry ammonia over the salt in a platinum boat and tube at a low red heat. The results attained in the various analyses establish the fact that pure fluoride of silver consists of 19 parts of fluorine and 108 of silver.

Argentic fluoride is usually in the form of yellowish brown, earthy fragments; but, when rendered perfectly anhydrous by fusion, it is a black, horny mass, with a superficial satin lustre, due to particles of free silver. It is extremely deliquescent and soluble in water. One part of the salt dissolves in 0·55 part by weight of water at 15·5° C.; it evolves heat in dissolving, and forms a strongly alkaline solution. It is nearly insoluble in absolute alcohol. The specific gravity of the earthy brown salt is 5·852 at 15·5° C. The specific gravity of its aqueous solution, 15·5° C., saturated at that temperature, is 2·61. By chilling the saturated solution, it exhibited the phenomenon of supersaturation, and suddenly solidified, with evolution of heat, on immersing a platinum plate in it. The solution is capable of being crystallised, and yields crystals of a hydrated salt. The act of crystallisation is attended by the singular phenomenon of the remainder of the salt separating in the anhydrous and apparently non-crystalline state, the hydrated salt taking to itself the whole of the water. The fused salt, after slow and undisturbed cooling, exhibits crystalline markings upon its surface.

The dry salt is not decomposed by sunlight. It melts below a visible red heat, and forms a highly lustrous, mobile, and jet-black liquid. It is not decomposed by a red heat alone; but, in a state of semi-fusion, or of complete fusion, it is rapidly decomposed by the moisture of the air, with separation of metallic silver. Dry air does not decompose it. In the fused state, it slightly corrodes vessels of platinum, and much more freely those of silver.

The salt, in a state of fusion, with platinum electrodes, conducts electricity very freely, apparently with the facility of a metal, and without visible evolution of gas or corrosion of the anode. A silver anode was rapidly dissolved by it, and one of lignum-vitæ charcoal was gradually corroded. A saturated aqueous solution of the salt conducted freely with electrolysis, crystals of silver being deposited upon the cathode, and a black crust of peroxide of silver upon the anode; no gas was evolved. With *dilute* solutions, gas was evolved from the anode. By electrolysis of anhydrous hydrofluoric acid with silver electrodes, the anode was rapidly corroded.

The electrical order of substances in the fused salt was as follows, the first-named being the most positive:—Silver, platinum, charcoal of lignum-vitæ, palladium, gold. In a dilute aqueous solution of the salt, the order found was:—Aluminium, magnesium, silicon, iridium, rhodium, and carbon of lignum-vitæ, platinum, silver, palladium, tellurium, gold.

The chemical behaviour of the salt was also investigated. In many cases, considerable destruction of the platinum vessels occurred, either in the experiments themselves, or in the processes of cleaning the vessels from the products of the reactions.

Hydrogen does not decompose the dry salt, even with the aid of sunlight; nor does a stream of that gas decompose an aqueous solution of the salt; but the dry salt is rapidly and perfectly decomposed by that gas at an incipient red heat, its metal being liberated.

Nitrogen has no chemical effect upon the salt, even at a red heat, nor upon its aqueous solution. Dry ammonia gas is copiously absorbed by the dry salt. In one experiment, the salt absorbed about 844 times its volume of the gas. The salt, in a fused state, is rapidly and perfectly decomposed by dry ammonia gas, and its silver set free. A saturated solution of the salt is also instantly and violently decomposed by strong aqueous ammonia.

Oxygen has no effect neither upon the dry salt at 15° C., or at a red heat, nor upon its aqueous solution. Steam perfectly and rapidly decomposes the salt at an incipient red heat, setting free all its silver. No chemical change took place on passing either of the oxides of nitrogen over the salt in a state of fusion

By passing anhydrous hydrofluoric acid vapour over perfectly anhydrous and previously-fused fluoride of silver, at about 60° F., distinct evidence of the existence of an acid salt was obtained. This acid salt is decomposed by a slight elevation of temperature.

Numerous experiments were made to ascertain the behaviour of argentic fluoride, in a state of fusion, with chlorine; and great difficulties were encountered, in consequence of the extremely corrosive action of the substances when brought together in a heated state. Vessels of glass, platinum, gold, charcoal, gas carbon, and purified graphite were employed.* By heating the salt in chlorine, contained in closed vessels formed

* Abstract of a paper read before the Royal Society.

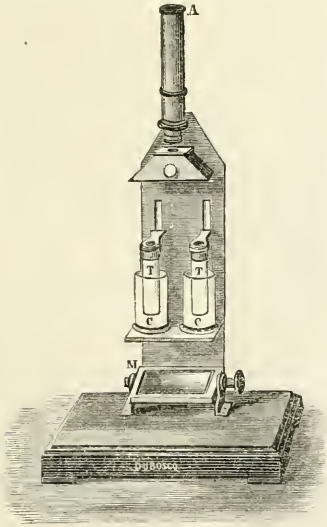
* In the next communication there will be described the results obtained with vessels formed of other materials.

partly of glass and partly of platinum, more or less corrosion of the glass took place, the chlorine united with the platinum and fluoride of silver to form a double salt, and a vacuum was produced. By similarly heating it in vessels composed wholly of platinum, the same disappearance of chlorine, the same double salt, and a similar vacuum resulted. Also, by heating it in vessels composed partly of gold, an analogous double salt, the same absorption of chlorine, and production of rarefaction was produced. And, by employing vessels partly composed of purified graphite, a new compound of fluorine and carbon was obtained.

DUBOSCQ'S NEW COLORIMETER.*

M. Duboscq has submitted to the Academy of Sciences his new colorimeter for measuring the differences of tint in solutions. The two liquids are placed in the two cylindrical vessels, c, c', of glass, fixed side by side, before the vertical shelf of the colorimeter.

In the two vessels, two tubes of smaller diameter, T, T', closed at the lower extremity by a disc of glass, may be raised and lowered by means of the movable pinions engaged by two racks cut into the vertical table. To each pinion is fastened a vernier, which is moved under a graduated scale, and which measures the distance between the bottom of the vessels and the lower disc of the movable tube.

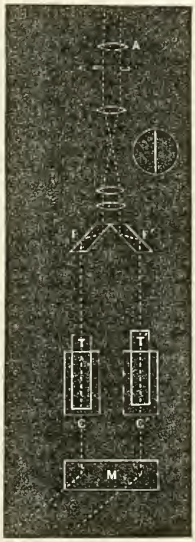


The luminous rays transmitted by the two columns properly illuminated by a mirror, M, placed above, and moved around in a horizontal axis, suffer each two reflections, within one of Fresnel's rhombs, P, P', and then arrive in the same field of vision, in such a manner that each shall illuminate the half of the field with a semi-disc or circle of yellow colour, more or less intense. These colours are observed with a small lens, which is nothing but the base of a terrestrial eye-piece, formed of four glasses, and which magnifies sufficiently, so that the field may be illuminated by the coloured plates with perfect uniformity.

The colours are proportional to the height of the columns if the liquid contain the same proportion of caramel; or proportional to the richness of the liquid in caramel, if the two columns have the same height.

In the last case, if we cause the height to vary, we have the same shade on these to semi-discs.

Suppose that the standard solution is in the cup to the right, and that we lower the interior disc or movable tube to 20 millimetres from the bottom of the cup; we will thus have a column of 20 millimetres, which gives to the half disc of the left-hand side a pale yellow colouration. Admitting, then, that the half disc at the right has the same colouration, but that the column of the liquid placed in the cup to the left has not a height of 40 millimetres, this informs us that the solution to be tried contains a proportion of caramel more than that contained in the standard liquid.



In fact, for the same colour on the two semi-discs, the proportions of caramel contained in the two liquids are inversely as the height which we give to the column of the liquids.

One hundred centimetres of the solution tried, contained, then, in the case we speak of,

$$\frac{0 \text{ gr. } 2}{2}$$

of caramel.

If we have dissolved, for example, 10 grammes of syrup in 100 c.c. of water, we should know that 10 grammes of the syrup contained one d. c. g. of caramel.

* For this description as well as for the illustrative cuts we are indebted to the courtesy of Professor Morton.

NEW METHOD FOR THE SEPARATION OF THE PLATINUM METALS.*

BY PROFESSOR BUNSEN.

In the metallurgic process of extracting platinum from its ores, there are obtained three products, which are admirably adapted for obtaining those rare metals which constantly accompany this metal. These products are :—

1. The "Ore residues," which remain behind after the mass of platinum, &c., has been extracted by aqua regia; these are rich in osmium and iridium, hence best adapted to the purpose of extracting these metals.

* Translated from his late contribution to the *Annalen der Chemie und Pharmacie*, entitled "Ueber das Rhodium," by W. H. Wahl. Communicated by Professor Morton, editor of the *Journal of the Franklin Institute*.

2. "Osmiridium," obtained, by mechanical washing, from the first residue, and which is best adapted for obtaining ruthenium.

3. The "Mother-Liquid Residues," left behind in the aqua regia solutions after reduction with iron, the platinum having previously been separated (with chloride of potassium?). These are rich in palladium and rhodium, and are the best for obtaining these metals.

The following researches were made with a material of the last sort; for each separation, 1 kilo. of residue was used.

The residue contains, with the exception of osmium, all the platinum metals, and is particularly interesting on account of its relatively great richness in rhodium.

Claus's mode of separation (the only one previous to this) involves the loss of much valuable material. To separate the rhodium from iridium, Claus used the old method proposed by Wollaston, which depends upon the solubility of the ammonium (or potassium) double salt of sesquichloride of rhodium in chloride of ammonium. The fact, however, that the salt $KCl,IrCl_3$, is taken up in considerable quantity by a solution of chloride of ammonium (or chloride of potassium) saturated with a rhodium double salt, a fact of which I have repeatedly convinced myself, is sufficient to awake the gravest doubts as to whether the metal given out to be rhodium, and to which Berzelius and Claus ascribe the atomic weight = 52, did not contain considerable quantities of iridium. I found it, therefore, necessary to leave the beaten track, and to search for a more exact method of separation.

[Separation of Platinum and Palladium from the other Metals of the Group.

The complete separation of rhodium, iridium, and ruthenium from platinum and palladium, by digestion with aqua regia, will not succeed with these questionable residues, as considerable quantities of the first-named metals are present in the form of hydrated sesquioxides, and partly present in a most finely-divided state, and in consequence, dissolve with the platinum and palladium; without taking into consideration the fact that the residue left behind by this digestion is only filtered with infinite difficulty.

On the other hand, it is easy to effect the separation of platinum and palladium from the others, almost completely, if the original material is mixed in a Hessian crucible with from ½ to ⅓ its weight of chloride of ammonium, heated until the latter is completely volatilised, allowed to glow gently until only the vapours of sesquichloride of iron show themselves, and then placed in a porcelain dish and evaporated to a syrupy consistency with from two to three times its weight of raw *commercial* nitric acid. By this treatment with chloride of ammonium, the metals present not belonging to the platinum group will have been partially converted to *lower chlorides;* rhodium, iridium, and ruthenium will have been rendered insoluble, and the silica, present as gangue, converted from a gelatinous mass to a finely-pulverulent condition, in which state it will admit of speedy filtering.

The chlorine compounds, produced by the chloride of ammonium, give us, upon digestion with nitric acid, just enough hydrochloric acid to dissolve the platinum to bichloride, while the metallic copper and iron present act in so far reducing upon the palladium (in solution in nitric acid) that it remains in solution, not as bichloride ($PdCl_2$), but as the protochloride ($PdCl$), which latter is not precipitated with chloride of potassium. The mass is diluted with water, filtered, and the solution saturated with chloride of potassium, and the greater part of the platinum separated pure as $KCl,PtCl_2$, which is washed out, first with chloride of potassium, and later with absolute alcohol (the last washings must not be added to the solution). This precipitate weighed 62 grms.

The filtrate is brought into a large flask (which can be made air-tight) which will not be more than half-filled with it. Chlorine gas is led into this flask, and the same is, from time to time, shaken vigorously until no further absorption of gas takes place, when all the palladium will have separated as a cinnabar-red precipitate of $KCl,PdCl_2$ (somewhat impure, however, from traces of platinum, iridium, and rhodium). This precipitate weighed 157 grms. The fluid from which these precipitates were obtained is now evaporated, not quite to dryness, with hydrochloric acid; and, upon addition of *just so much water as was necessary* to dissolve out the chloride of potassium and other soluble salts (aiding the operation by rubbing with a pestle), there remained behind a dirty, yellow-coloured precipitate. This was separated by filtration, boiled with caustic soda and a few drops of absolute alchohol. Hydrochloric acid was added to dissolve the precipitate formed, and the liquid then saturated with chloride of potassium. Result was a precipitate of 13·5 grms. of chemically pure $KCl,PtCl_2$. The mother liquid contained only copper, and no platinum metals.

The purification of the cinnabar-red precipitate of palladium was accomplished as follows:—It was dissolved in boiling water, whereby a portion of the chloride dissolves, with evolution of chlorine, to $PdCl$. It was then evaporated with 60 grms. of oxalic acid, and dissolved again in a solution of chloride of potassium; whereupon 42 grms. of $KCl,PtCl_2$ remained behind, which, upon testing, proved chemically pure. It was washed out as before.

The brown liquid was then somewhat concentrated upon the water-bath; and, upon cooling, there separated 19 grms. of bright green, well-formed crystals of $KCl,PdCl$ (with some chloride of potassium), which, upon testing, likewise proved free from the other platinum metals.

The fluid poured off from these crystals was then neutralised carefully with caustic soda, and gave a very slight precipitate of copper and iron, which was filtered off. Upon adding iodide of potassium to the filtrate, all the palladium separated as PdI. To avoid adding an excess of the reagent, it is best to take, from time to time, a drop from the fluid with a capillary tube, and bring the same upon a watch-glass. As long as the precipitation is incomplete, the drop appears, upon a white background, *brown;* when complete, it is *colourless;* when the reagent is present in excess, it is *red.* This weighed 77 grms., and was tested for its purity by reducing it to metallic palladium, and then heating and dissolving in nitric acid; when pure, it must dissolve completely. The whole mass was now reduced in a slow stream of hydrogen gas (whereby the iodine can be obtained again, as hydriodic acid, by absorbing with water). At last, the mass must be strongly heated, to decompose slight traces of the subiodide of palladium (Pd_2I) which are formed.

The mother liquid from which all this platinum and palladium has been obtained may contain some iridium and rhodium; it is, therefore, evaporated to dryness with a little iodide of potassium, whereby a mixture of

the iodides of rhodium and iridium separates. This can either be dissolved in aqua regia and the two metals separated (as will hereafter be described) by the bisulphite of soda, or it can be united with the portions from which these metals will be obtained.

Separation of Ruthenium, and of Rhodium and Iridium.

The residue from 1 kilo. of the original material which remained, after treatment with chloride of ammonium and nitric acid, weighed 400 grms. It was treated as follows, to get the metals in a form adapted to further chemical treatment.

The method depends upon the behaviour of chloride of zinc to zinc. If a piece of zinc be smelted, it rapidly covers itself with a stratum of oxide. If, to the smelted metal, a metal like iridium be added, the oxide stratum hinders the latter from coming into contact with the zinc, even though it be pushed beneath the surface. If, however, a few grains of chloride of ammonium be given to it, ammonia, hydrogen, and chloride of zinc will be formed, which last dissolves the oxide stratum to basic chloride of zinc. The zinc below resembles mercury in lustre and movability. As soon as the chloride has dissolved as much of the oxide as is possible for it, the oxide stratum again forms, and is instantly removed again by the addition of more chloride of ammonium. The melted zinc, strewn with chloride of ammonium, also possesses, like mercury, the property of attacking other metals, if the affinity exists of forming with them alloys. By strewing chloride of ammonium upon the melted zinc, a quiet surging is kept up as the ammonia and hydrogen are given off. Many oxides and chlorides (among which are those of the platinum metals) are, when they come into contact with this atmosphere of reducing gases, and with the basic chloride of zinc, instantly reduced and dissolved to alloys by the zinc. [We have here a means of separating quantitatively all metals which are not dissolved by zinc from those which are.] In making the solution, the zinc, in a porcelain dish, should be constantly rotated: the gangue remains in the basic chloride. The regulus, immediately upon solidifying, should be taken from the capsule, out of the yet-fluid basic chloride, and washed off with acetic acid until all the basic chloride is dissolved away. The gangue can be quantitatively determined by filtration and weighing. If the regulus is not immediately removed, the containing vessel will be broken, owing to the unequal expansion of the porcelain and the metal.

The best proportions for a quantitative separation are, to 1 part of the expected platinum metals, from 20 to 30 parts of zinc. For an ordinary separation, 7 parts of zinc are sufficient.

For the extraction of the residues remaining after our treatment with nitric acid, this method is admirably adapted. By fusing only once with zinc for two or three hours, all the platinum metals are extracted. The operation is the following:—

From 3 to 3·5 kilos. of commercial zinc were fused in a 2-litre Hessian crucible, chloride of ammonium, from time to time, strewn upon it, the 400 grms. of residue, previously heated to faint glowing with chloride of ammonium were added, and the temperature kept, for two or three hours, just above the fusing point of the alloy, by adding, whenever the mass threatened to solidify, some chloride of ammonium. The mass is divided into three strata after solidification has taken place.

The *outer* stratum, easily broken away by a blow from a hammer, contains *no* platinum metals. The *next* contains some particles of the zinc and platinum alloy, imbedded in the basic chloride of zinc; it is porous, and not very thick.

The *inner* stratum consists of a frequently beautiful crystalline regulus. To obtain the alloy from the middle stratum, it is only necessary to wash repeatedly with water; and the alloy gained is, of course, to be added to the regulus. To obtain this regulus as pure as possible, it was again fused with 500 grms. of zinc and some chloride of ammonium, then granulated in water, and the granules dissolved in fuming hydrochloric acid. The acid attacks the regulus with the greatest energy, and the solution was completed in less than an hour. The chloride of zinc can be used for the next operation.

The platinum metals are found at the bottom of the vessel, in the form of a finely-divided black powder, which is impurified with zinc, and with traces of iron, copper, &c., from the latter. It cannot be purified with nitric acid, nor with aqua regia, for part of the platinum metals will thereby be dissolved, or, at best, so suspended in the fluid that filtration is impossible. If, however, the powder is treated with hydrochloric acid, singularly enough, all the impurities are dissolved; not only zinc and iron, *but also lead and copper, dissolve readily, with the generation of hydrogen.* The explanation is readily found in electrical currents produced by the contact of the metals, the stream passing from the positive zinc, iron, &c., to the negative platinum metals, hydrogen being given on the latter, and chlorine on the former, and uniting with them. The metals (rhodium, iridium, &c.), after thorough washing, weighed 65 grms. This powder possesses the property, upon being gently heated, of exploding weakly, and, when highly heated, with violence, the explosion being accompanied with the evolution of light; thereby neither hydrogen, nor chlorine, nor nitrogen, nor aqueous vapour, are given off; and, as these are the only elements which it is possible that the metallic powder could have taken up, it must be assumed these metals are, by our treatment, converted into an allotropic condition, and that, upon heating, they return, with more or less energy, to their original condition. The powder contains, mainly, rhodium and iridium; but there are traces present of platinum, palladium, lead, copper, iron, and zinc.

It was intimately mixed with about three or four times its weight of completely anhydrous chloride of barium, and a stream of chlorine gas led over it at a tolerably high temperature. The operation is concluded when particles of sesquichloride of iron show themselves on the neck of the flasks containing the powder. It is carefully brushed away with filter paper. Some water was now added, and the mass of the platinum metals dissolved with the evolution of heat. There remained behind 13·7 grms. of insoluble matter, which, upon reduction with hydrogen, alloying with zinc, and treatment with hydrochloric acid, furnished 4·5 grms. of ruthenium. From the original 65 grms. of metal-powder, there were dissolved, in three hours, and with the use of four ordinary burners, 57 grms. of the platinum metals; there being consumed thereby 415 grms. of 85 per cent black oxide of manganese. From this solution all the chloride of barium was removed by careful addition of sulphuric acid [see the precipitation of palladium]. The platinum metals were now completely freed from all other metals, by reduction with hydrogen [with 100 grms. of material, this operation will require five or six days], the temperature being, throughout the operation, maintained at nearly 100° C., by means of the constant

water-bath. Platinum and palladium chiefly separate first; then mainly rhodium; and the last portions consist almost entirely of iridium. It is best to break off the operation when the fluid has assumed a greenish-yellow colour. The last portions of iridium (obtained by evaporating the solution to dryness, fusing with carbonate of soda, and treatment with aqua regia) were added to the portion, afterward to be again rendered workable by renewed treatment with chloride of barium. The operation of reduction is hastened by concentrating the fluid; in doing which care must be taken to guard against explosion, on account of the hydrogen. The separated metals were treated with aqua regia, and the platinum and palladium thus dissolved were separated from each other as above described. The traces of rhodium and iridium in the mother liquid can be removed entirely by continued boiling with iodide of potassium (whereby they precipitate as iodides) dissolved in aqua regia and added insoluble portion.

This insoluble and partly-oxidised portion was now again reduced in hydrogen gas, treated, as before described, with chloride of barium, and, after the removal of the barium, the last traces of platinum and palladium removed by boiling with caustic soda. Rhodium and iridium now alone remained to be separated.

The brown-red fluid was, for this purpose, evaporated with hydrochloric acid, and, after filtration, treated with bisulphite of soda—

$$\left(\begin{matrix}NaO\\HO\end{matrix}\Big\}S_2O_4\right)$$

in *great excess*, and the whole allowed to remain quietly *in the cold* for several days. The double salt of rhodium ($NaOSO_2,RhOSO_2$) separates slowly, giving a lemon-yellow precipitate. The solution becomes lighter and lighter, and finally almost colourless. The colour of the precipitate changes with that of the fluid, becoming, with it, lighter. This precipitate, upon washing, contained the rhodium almost pure.

Upon heating the fluid gently, a yellow-white precipitate separated, which consisted mainly of rhodium, but contained, also, some iridium. After filtering off this precipitate, the solution, upon being concentrated to a small volume, gave yet two precipitates—

1. A curdy, slowly-separating, yellowish-white precipitate, nearly chemically pure iridium, containing but the faintest traces of rhodium.

2. A heavy, crystalline powder, quickly separating, which was readily freed from the first by decantation, and weighed 16 grms. Upon testing, it gave all the reactions for iridium, but likewise some peculiar reactions not shown by the latter. It may possibly contain a new metal.

Exclusive of these 16 grms., the precipitate (the first) weighed 99·5 grms. The mother liquid was free from platinum metals. The complete separation of rhodium from iridium was accomplished by treating the yellow precipitates with concentrated sulphuric acid. They were brought in small portions into the acid, heated in a porcelain capsule until all the sulphurous acid had escaped, and then left upon the sand-bath until all the free sulphuric acid had been driven off; and the sulphate of soda formed. Upon boiling the mass of water, all the iridium dissolves as sulphate, with a chrome-green colour; while the rhodium remains behind as a flesh-red double salt of soda and rhodium oxide. It (the latter) was washed by boiling in aqua regia, and decanted with water. It is insoluble in water, hydrochloric or nitric acids, and in aqua regia. The rhodium and iridium are now completely separated. The rhodium salt weighed 33·2 grms.

The following are the weights of the various precipitates obtained from 1 kilo. of the original residue:—

	grms.
$KCl,PtCl_2$	117·5
PdI	77·0
KCl,PdCl	19·0
$NaOSO_2,RhOSO_2$	33·2
Ir_2O_3	9·1
Ru(+Ir)	4·5

The first yellow precipitate obtained in the cold by the bisulphite of soda, gave, by this treatment, the rhodium quite pure. The second and third precipitates, containing much iridium, gave a very fine rhodium, but still slightly impurified with iridium. The products, therefore, obtained by this treatment with sulphuric acid (which betray their impurification with iridium by their somewhat brownish colour) were collected for themselves, the rhodium separated therefrom by glowing, treated again with chloride of barium, and the operation of separation repeated. The green solution, containing only iridium, was gradually heated over an ordinary burner, in a porcelain capsule, and, afterwards, upon the sand-bath, to remove the excess of sulphuric acid; and, finally, the capsule and its contents were highly treated in a Hessian crucible. There is formed thereby sulphate of soda and sesquioxide of iridium. Upon boiling the mass with water, the last remained behind as a black, insoluble powder, which was readily washed by decantation. It weighed 9·1 grms.

In these operations, the new filtering apparatus and the continuous water-bath with which I have furnished my laboratory materially shortened the labour.

REPORTS OF SOCIETIES.

CHEMICAL SOCIETY.

January 20th, 1870.

Dr. A. W. Williamson, F.R.S., &c., *President, in the Chair.*

The following gentlemen were elected Fellows:—J. Bell, A. Bird, G. R. Hislop, E. Lapper, H. Seward.

The first paper read was—"*Note on the Absorption of Mixed Vapours by Charcoal*," by John Hunter, M.A., Queen's College, Belfast.

The author, some time ago, published, in the *Journal of the Chemical Society* (May, 1868), the results obtained by absorbing the mixture of two vapours by means of coccanut charcoal. He found that the absorption was increased when one of the vapours was at a temperature near to its point of condensation; and he explained the phenomenon by assuming that, when a fragment of charcoal is introduced into a mixture of two vapours, the one which is nearest to its point of condensation is first absorbed, and this, in its condensed state in the pores of the charcoal, aids the absorption of the other vapour. According to this view, a succession of condensations is going on. The theory is strikingly illustrated in experimenting with a mixture of water vapour and ammonia gas (obtained by heating an aqueous solution of ammonia of sp. gr. 0·88), when the mixture is much more largely absorbed than either the gas or the vapour separately. The mean of a set of experiments made at 100° and a mean pressure of 706·2 m.m. was—316·6 vols. of the mixture absorbed by 1 vol. of charcoal.

The President remarked that the results were entirely in accordance with what was expected on theoretical grounds.

The next communication was—"*The Composition of Iron-Rust*," by Dr. Craco Calvert.

The author had lately occasion to analyse rust obtained from two different places—from the outside of the Conway Bridge, and from Llangollen, North Wales; and he found both specimens to be composed as follows:—

Sesquioxide of iron	92·900
Protoxide of iron	6·177
Carbonate of iron	0·617
Carbonate of lime	0·295
Silica	0·121
Ammonia	traces
	100·000

This result induced the author to enquire to which of the constituents of the atmosphere the formation of rust is chiefly due. To this end, clean blades of steel and iron were put into tubes filled respectively with oxygen, oxygen and a little carbonic acid, oxygen and moisture, &c. The blades were introduced into the tubes, which then were filled, over mercury, with oxygen. But this proved an unsatisfactory method, inasmuch as always some globules of mercury remained adhering to the iron, whereby a galvanic action was produced, which, of course, induced a rapid oxidation. To avoid this, the tubes were filled simply by displacement of the atmospheric air. The blades were then left exposed to the action of the different agents for a period of four months. The results were as follows:—

Blades in dry oxygen.—No oxidation.

Blades in moist oxygen.—Out of three experiments, only in one a slight oxidation.

Blades in dry carbonic acid.—No oxidation.

Blades in moist carbonic acid.—Slight incrustation of a white colour. Out of six experiments, two did not give this result.

Blades in dry carbonic acid and oxygen.—No oxidation.

Blades in moist carbonic acid and oxygen.—Most rapid oxidation.

Blades in dry oxygen and ammonia.—No oxidation.

Blades in moist oxygen and ammonia.—No oxidation.

These facts led the author to assume that it is the presence of carbonic acid in the atmosphere, and not oxygen or water vapour, which determines the oxidation of iron.

The author next investigated the behaviour of iron in water into which, successively, oxygen, carbonic acid, a mixture of the two gases, &c., was conducted. The results were analogous to those above mentioned, inasmuch as the most effective oxidation took place when a mixture of oxygen and carbonic acid was introduced into the water. The action commenced immediately, and, in a short time, a dark precipitate covered the bottom of the vessel. The oxidation, in these cases, was not due to the fixation of the oxygen dissolved in the water, but to oxygen liberated from the water by galvanic action; the occurrence of hydrogen collected above the liquid in the bottles proved this sufficiently. A further evidence for the supposition that the oxidation of the iron is effected through the decomposition of the water is found in the fact that, when into distilled water which had previously been deprived of all its absorbed gases by continued boiling a bright blade is introduced, it became, in the course of a few days, here-and-there covered with rust. The spots where the oxidation had taken place proved to be impurities in the iron, which had induced a galvanic action, just as a mere trace of zinc, placed on one end of the blade, would establish a voltaic current.

Finally, Dr. Calvert investigated the state of iron in alkalies; and he discovered that, not only the solutions of the caustic alkalies, but of their carbonates as well, protect iron against any oxidising action.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, January 11, 1870.

E. W. Binney, F.R.S., F.G.S., *Vice-President, in the Chair.*

The Chairman said that he had observed, at Cheetham Hill, on the evening of Monday, the 3rd inst., at 7.30 p.m., a singular display of the Aurora Borealis. It consisted of an arch of white light, 4° to 5° in breadth, a little south of the zenith, extending from east to west, and passing through the Pleiades; and a column of deep crimson colour, nearly due north, extending from the horizon to about 40° altitude, having slightly the character of streamers. The white arch, also, moved slowly to the south. The intensity of the red colour in the pillar was greater than any he had previously observed.

Dr. Joule said he had not seen the aurora of the 3rd instant referred to by the Chairman; but, having been engaged on the same day in making observations with his new dip circle, he had noticed some remarkable disturbances in the magnetic dip, which no doubt were connected with the auroral display. He had also noticed similar disturbances of the dipping needle during the gale on Saturday, the 8th instant.

Dr. Joule exhibited his current meter, and with it, in connection with a galvanometer, made an experiment to determine the horizontal intensity of the earth's magnetism in absolute measure. The result gave 3·83 as the value of this element in the hall of the Society. The current employed was produced by a single cell of a Bunsen's battery.

MICROSCOPICAL AND NATURAL HISTORY SECTION.

January 3, 1870.

R. D. Darbishire, B.A., F.G.S., *in the Chair.*

Dr. W. Roberts exhibited some specimens of urinary calculi, composed of cystine; also some crystals of the same, obtained by evaporation in the open air of the ammoniacal solution. Six-sided plates of mother-of-pearl lustre were obtained in this way which formed brilliant objects for the microscope.

Dr. Roberts remarked on the great rarity of cystine calculi, many large museums not possessing a single specimen. He had, in his own collection, three specimens; and in the Museum of the Manchester School of Medicine, there were portions of two very fine calculi. A certain historical interest attached to one of the latter, a piece of which was presented, by the late Mr. Ransome, to Baron Liebig, during one of his visits to Manchester. The analysis of this piece led to the rectification of a curious error in the original formula for cystine, published by Prout and Lassaigne. These eminent chemists had deduced the formula $C_6H_8NO_8$; but the Giessen analysis discovered 20 per cent of sulphur, which brought the true formula to $C_6H_8NS_2O_4$, the 2 atoms of sulphur having been before erroneously reckoned as 4 atoms of oxygen.

Mr. J. Sidebotham read "*Notes on the Pupa and Imago of Acherontia atropos.*"

Mr. W. Boyd Dawkins sent, for exhibition, some very interesting microscopic sections of *Eozöon Canadense*, which are the more valuable as being those which have passed through the hands of Sir W. E Logan and Dr. Carpenter.

Mr. J. B. Dancer, F.R.A.S., presented the Section with a box containing twelve new polarising objects. These partly consisted of some of the hard fatty acids, which form very effective objects, and partly of crystallisations of some of the hydrocarbon compounds, which compete with the best specimens of polarising objects of the present day.

[English Edition, Vol. XXI., No. 531, pages 42, 43]

GLASGOW PHILOSOPHICAL SOCIETY.

(Chemical Section.)

The ordinary meeting of the Chemical Section was held on Monday last, Mr. Alexander Whiteland, Vice-President, in the Chair. After the admission of some new members and the transaction of some other business, a paper was read by

Mr. J. Wallace Young, "*On Artificial Alizarine.*" He characterised madder and its preparations as being among the most useful dye-stuffs used in calico-printing and dyeing. The importance of madder is due to the fact that with different mordants it gives a great variety of colours,—iron mordants giving all shades from black to delicate purple; those of alumina giving colours from a dark red to a fine pink; and a mixture of them giving various shades of chocolate. Madder root has undergone probably more chemical investigation than any other colouring matter—the investigators being Robiquet and Colin, Claubry, Persoz, Runge, Schunck, Higgin, &c. The most important colouring matter is alizarine; from it may be obtained all the durable and brilliant colours yielded by madder itself. Mr. Young described the method by which alizarine may be obtained readily from madder root, and mentioned that the substance appears ultimately as a sublimate of fine orange-red needles, which are slightly soluble in hot water, and readily soluble in boiling alcohol. Owing to the high price of madder and madder preparations, much interest attaches to every substance which purports to be a substitute for madder. A good substitute would be gladly welcomed. M. Roussin announced a few years ago that he had succeeded in obtaining artificial alizarine from naphthaline, but further investigation proved that he had been mistaken. More recently, it had been announced in the Chemical News and elsewhere that artificial alizarine had been successfully obtained from anthracen.

Mr. Young then stated the results of his experiments upon two madder substitutes, one of continental manufacture, a thin dark coloured paste containing 5·7 per cent of dry residue, the other of English manufacture, supplied in the form of an opaque brownish liquid. The former contained a large amount of coloured matter, but further purification was necessary before it could be used as a madder-substitute. When mordanted cloth dyed with it was boiled with solution of soap, the colours were found to be rather fugitive. Cloth prepared for Turkey-red absorbed the dye-stuff readily, but the same want of fastness was observed. When mixed with iron and aluminous mordants, and printed on in the way in which madder extract is used, the colours were found to be dull and not sufficiently fast. A sublimate obtained from the dried paste closely resembled natural alizarine, but was rather lighter in colour. It dyed mordanted cloth well and withstood treatment with soap. The English made madder substitute yielded a red rather yellower than that yielded by natural alizarine, a black of equal, if not superior quality to madder-black, but the chief difference was in the purple, which was rather slate-coloured than anything else, contrasting most unfavourably with the fine shade of colour given by madder. The yellowness of the red seemed to depend pretty much on the proportion of tin salt used in the clearing. As with madder and its preparations, the development of the colouring matter of the artificial alizarine is increased by tanning materials, as sumac, and deteriorated by chalk. The dried residue of the brown artificial alizarine liquid yielded by sublimation a crystalline body of a yellower shade than that of the crystals of the natural alizarine. In order to compare the artificial alizarine with the natural substance and with purpurine, which is another madder extract, the author dissolved each of them in weak ammonia, and added barium-chloride; they all yielded purplish precipitates. The natural alizarine precipitate was of a fine bluish-purple colour, and the supernatant liquor was almost quite clear; that from the artificial product was much redder, and the supernatant liquid was highly coloured; the purpurine precipitate was of a purplish-red colour. The natural alizarine and purpurine precipitates did not seem to be much affected by being washed several times with cold water, but the artificial alizarine precipitates gradually dissolved in the washing water and finally disappeared. Mr. Young thoroughly tested the dyeing powers of the new alizarine by comparing the results produced upon mordanted cloth either with equal weights of sublimed alizarine obtained from the two artificial preparations and from madder, and of purpurine; he showed the specimens of cloth so treated. Instead of the dark full red given by the natural substance, the artificial alizarine yielded only a yellowish-red, much like that of the purpurine. Its purple was of a slaty tint, but the chocolate and black differed very slightly from those of the natural alizarine. The purpurine scarcely gave any purple, and the same is true of the Continental and English madder-substitutes. Alcoholic solution of natural alizarine gives a fine purple colour with copper acetate, and with the same reagent the artificial preparation gives a very red purple. No characteristic bands appear in the spectrum when artificial alizarine is used, and, therefore, purpurine is shown to be totally absent. The author was not aware if anything had been done towards establishing a formula for the new alizarine, but, his opinion arrived at after performing many practical experiments, was that there was some essential difference between the artificial and the natural substance. He had found no superiority in the new substance. In a supplement to the paper of which the foregoing is an abstract, Mr. Young said that the manufacture of artificial alizarine is carried out in two or three ways by continental chemists, and from the examination which has been made of the products, it would appear that some of them consist of a mixture of alizarine and purpurine, in different proportions, and some of alizarine, or of a substance intermediate between the two. It had been said that it was more advantageous to use the artificial alizarine as a dry paste, rather than in the dry state, but he could find no difference in the dyeing power. He had treated the artificial alizarine with boiling dilute sulphuric acid, as in garancine making, afterwards washing thoroughly and drying: he had also dissolved it in sodium carbonate, precipitating with acetic acid, washing, and drying; but the colours given on drying did not seem to be modified in any way.

A discussion followed, in which several gentlemen took part. There seemed to be much doubt as to the mode of preparing the artificial alizarine, and if it could be produced in large quantity, considering the small amount of anthracen which exists in coal tar. On that point, however, it was stated by Mr. Hogg that it could be supplied in considerable quantities and at such a price as would make it cheaper than madder.

A paper then followed "*On the Estimation of Iodine and Bromine in the Mother Liquors from Saltpetre and in Kelp,*" by Dr. Clark. The author submitted a process by which the tediousness may be avoided which attends most of those which aim at estimating iodine and bromine existing in the combined state in presence of a large excess of chloride. He considered it specially applicable for the estimation of iodine and bromine in the mother liquors from saltpetre. A measured quantity of the liquor is introduced into a long tube with twenty alkalimeter measures of bisulphide of carbon; and nitrous-sulphuric acid (prepared by passing nitrous acid through sulphuric acid) is added, drop by drop, till iodine ceases to be liberated. The tube is inverted several times after the addition of each drop of acid, in order that the iodine may at once be dissolved by the bisulphide of carbon, to which it gives a violet colour, varying in intensity with the amount of iodine in solution. The quantity of the iodine is estimated by comparing the degree of the colour with that which results when a standard solution of iodide of potassium is used in the same way. The author affirmed the delicacy of the reaction to be such, that 0·01 gr. would communicate a distinct rose tint to the bisul-

phide of carbon. When the amount of iodine exceeds 0·2 gr. of iodine in the quantity operated on, a difficulty occurs, as the violet colour becomes so deep that the various shades cannot be distinguished with accuracy. When all the iodine is separated by the bisulphide of carbon, the solution containing the bromine is introduced into another tube, and the bromine is liberated by chlorine-water in the usual way, and taken up by a fresh quantity of bisulphide of carbon. In this case, an orange colour is the result, and the amount of bromine may be estimated by comparing the colour with that resulting when a solution of bromide of potassium is used of known strength. A sample of saltpetre mother liquor treated in the way mentioned gave the results—

Iodine.....	145·3 grs. per gallon.
Bromine.....	2094·5 " "

The same process, slightly modified, may be used to determine the amount of iodine and bromine in kelp.

Mr. Stanford said that, so far as iodine is concerned, the process mentioned by Dr. Clark was a good commercial process, but he doubted if it would be of use with bromine.

Mr. Tatlock considered that the process was not specially novel, and that it was liable to the same objections that apply to colour tests generally. He could put little or no confidence in such tests.

NOTICES OF BOOKS.

Elementary Chemistry. By the Rev. William Grist Grammar School, Bewdley. Part I.—*The Elements* Birmingham: Cornish Brothers. 16 pages; 8vo.

The author of this work, imagining, we suppose, that there was a great dearth of elementary works on chemistry, determined to bring his own grist to the mill. We are greatly surprised that he could find a miller to grind it, and we pity those who may attempt to eat the bread which has resulted; for, without the least doubt, it will disagree with the first person who partakes heartily of it.

We have an account of the elements (which, the author informs us, "are more than sixty in number, more than fifty of which are metals") compassed in a span of sixteen small octavo pages. We can easily imagine how lengthy and lucid the descriptions of each element must be. For example, strontium receives the following amount of notice:—"This greatly resembles barium, but its salts are not poisonous. One of its salts is used in red fire." While molybdenum has nearly a line devoted to it—"Molybdenum is white, brittle, and very infusible." What an example to prolix writers! What can be more terse than the above?

Now, as an example of the author's English, we may as well quote the first paragraph in the book:—"Chemistry is the science that has for its object the discovery, nature, properties, and combinations of the elementary substances, and also the laws which govern the production of their combinations." Again, in speaking of the non-metallic elements, he remarks, with singular perspicuity, "These may be divided into three groups—invisible gases, chlorine group, and (excepting iodine) solids." As to the author's Latin, he gives *Hydrargyrus* as the term for mercury. As to his general accuracy, he informs us that iodine is "obtained from the ashes of seaweed, after the soluble parts have been extracted;" that sulphur "melts at a little above the boiling point;" that the specific gravity of potassium is 0·086, of sodium 0·097, and of lithium 0·059; that sodium "becomes red-hot when it touches cold water, and burns with a bright yellow flame if the water be hot;" that "fire appears to be the effect of violent combustion." We will cease here. We will not ask how, when, and where the author studied chemistry. We will not ask what has induced him to rush with such inconsiderate haste into print. We will not ask the aim, object, design of the work before us. But we will ask him if he is aware of the spirit which is abroad among our schools in regard to science teaching; if he knows of the many accurate, concise books by eminent men, written specially for the requirements of our schools; if he recognises the injury which he is doing by making public false science, inexact method, the truths of nature perverted by a sojourn in the caves of his mind, and returned maimed into the light of day.

At a time when the desire for sound training in science is becoming general, a work of this nature does infinite harm, and brings the contempt of the public both upon the science and its teacher. We recommend Mr. Grist to give up writing on chemistry; to devote as much time as he can spare to the study of it for the next twelve months, and then, if need be, to teach it by the help of some good work specially adapted for schools—such as the work of Roscoe, of Bloxam, of Harcourt and Madan, of Barff, &c.

Chemistry for Schools, an introduction to the Practical Study of Chemistry. By C. Haughton Gill, Assistant Examiner in Chemistry at the University of London. 100 Illustrations. London: James Walton, 1869. 315 pages.

This work is intended to be used as a manual for schools where chemistry forms a part of the ordinary routine work; and one of its main objects is the cultivation of "scientific habits of thought." It does not appear to differ materially from any of the many class-books which have appeared during the last few years; it is most nearly related to Dr. Williamson's "Chemistry" (Clarendon press series), and his nomenclature is followed. The text is somewhat uneven, and in another edition should be carefully examined; in one portion it is turgid, in another, rugged and clumsily constructed; thus the "*genesis* of ammonia," and the "change of proportional composition" is described in one place, while in another, we find such expressions as "got rid of," "a *bit* of this, a *pinch* of that," "the wood is re-lit with a little pop," "To do this, it is necessary to act on it by other bodies, which must be admitted to be what they are described to be," and so on. All this, however, refers to the diction only; the subject matter appears to be sound and well arranged. There is evidence of much hard work, and the book is eminently comprehensive; otherwise it is admirably printed, and of very convenient form, and we should be sorry to regard it as labour lost. The work is divided into twenty-two chapters; to each of which is appended a list of questions. The appendix contains a very useful chapter on "crystalline systems," illustrated by woodcuts of the typical forms. There is also a chapter on the metric system, by Mr. Walker, one of the Mathematical Masters in University College School, in which we find ready rules for various conversions; thus—"To convert kilomètres into miles, multiply by 5 and divide by 8. To convert mètres into yards, multiply by 35 and divide by 32. To convert decimètres into feet, divide by 3. To convert centimètres into inches, multiply by 4, and reject the last figure. To convert millimètres into inches, or decimals of the inch, multiply by 4, and point off the last two figures. To convert miles, yards, feet, inches, into metric equivalents, multiply by the divisors, and divide by the multipliers, as given above."

The Examination of Petroleum and other Mineral Oils according to the Petroleum Act, 1868. By A. Norman Tate, Analytical Chemist, &c., &c. London: H. Greenwood. 1869.

The author of this small pamphlet has, we think, done good service to all who have in any way to do with petroleum or other mineral oils, by writing this very clear paper on a subject which, as is justly pointed out by its experienced author, is not so well defined as it ought to have been. The paper contains valuable and definite directions about the testing or ascertaining of what is termed the *flashing point*. We recommend the perusal of this pamphlet to all parties in-

terested in this subject, and especially to those who by the Act are called to carry out the operative tests, viz, the inspectors of weights or measures, or other persons duly appointed to inspect weights and measures as testers of petroleum. We entirely approve of the author's remarks made on this score.

A Manual of Diet for the Invalid and Dyspeptic, with a few Hints on Nursing. By Duncan Turner, Licentiate of the Royal College of Physicians, &c., &c. London: John Churchill and Sons. 1869.

The object the author has sought in publishing this small essay is to convey, in a few words, avoiding as far as possible technical terms, necessary information to a larger class than would be expected from the title of the book, which contains six chapters and an appendix of formulæ. We find that the volume contains, written in a popular language, a great deal of useful hygienic information, and we heartily recommend it to all households, where, especially in the hands, or better still in the head, of the mistress, this useful knowledge deserves a permanent place. The appendix is highly commendable for its sound directions as regards the preparation and cooking of food, which has more to do with digestion than is commonly supposed in this country.

Addresses at the Inauguration of Charles William Eliot as President of Harvard College, Tuesday, October 19, 1869. Cambridge (Mass.): Sever and Francis. 1869. 65 pp., 8vo.

On the 19th of September, 1868, Dr. Thomas Hill resigned the office of President of Harvard College; and on the 19th of October, 1869, Mr. Charles William Eliot was formally inducted into office in his stead. Mr. Eliot is known to many of us as a writer on chemistry: to some of us as a man of singularly sound and accurate thought, of high culture and of liberal views, and as a kindly genial gentleman. Let us glance for a moment at the addresses which were delivered at the inauguration of Mr. Eliot, and specially at his own, which derives additional interest from the fact that he has paid special attention to the subject of education, and has watched the growth of the educational system of his own country, comparing it with those of the principal European nations, and particularly with our own college system.

The form of induction into office of the president of a college is very different in America from that which is adopted in England. In the invitation to the Alumni of Harvard College, it is stated that "A procession will be formed in Gore Hall, at half-past two p.m., under the direction of Leverett Saltonstall, Esq., and the exercises in the Church will begin at three o'clock p.m. Immediately after the exercises in the church, President Eliot will hold a reception at the President's House in Quincy Street." The "Exercises" on this occasion were nine in number, and consisted of:—

1. "Music by the Band.
2. Choral: 'Let us with a gladsome mind.'
3. Prayer by the Rev. Dr. Peabody.
4. Congratulatory Address in Latin, by John Silas White, of the Senior Class.
5. Induction into Office, by John Henry Clifford, President of the Board of Overseers.
6. Chorus: 'Domine, salvum fac Præsidem Nostrum.'—J. K. Paine.
7. Address by President Eliot.
8. Chorus from the Antigone of Sophocles: 'Πολλὰ τὰ δεινὰ κουδὲν ἀνθρώπου δεινότερον πέλει.' 'Wonders in Nature we see.' —Mendelssohn.
9. Benediction, by Rev. Dr. Walker."

The Latin address is, as we should expect, less florid and elaborate than those which are given on somewhat similar occasions in the French and German Universities; the 'Amplissimi, Nobilissimi, Præstantissimi Eminentissimi," commencement is omitted, and it begins simply and to the point, "Convenimus hodie," while it is concluded by an exceedingly apt and reverent phrase:—"Precamur autem a Deo Optimo Maximo ut signis illis venustis ac pulchris, quæ verbo inter se discrepantia, re prorsus unum videntur sonare, semper tu et nos, ut diligimus, sic utamur,—'Christo et Ecclesiæ' atque 'Veritas.'"

In the Inductory Address, Mr. Clifford alludes to certain changes recently made in the constitution of the College—notably, the separation of the College from the State—a change "which has wisely taken from the Legislature and confided to the Alumni of the College, the choice of the Board of Overseers." It has also given the College a greater independence, since it now stands alone, unsupported by the State, and is dependent upon itself for the maintenance of the position which, as the oldest American University, it ought to occupy. Mr. Clifford then speaks of the power committed to the President, and of the nature and result of his influence upon the Alumni; he advocates a system of "personal examination, by which the Faculty might test the student's disposition to make the best of his opportunities, according to his capacity," in place of the unjust system of arbitrary marks by which mediocrity is too often crushed out by genius. "Mediocrity," he truly remarks, "is the unattractive average of the race; though its capabilities, wisely stimulated and diligently cultivated, constitute the working forces of the world. Genius, with its brilliant, but often erratic efforts, is the rare exception in human endowment. The former needs all the fostering and patient care the teacher can bestow; the latter is self-reliant and sufficient unto itself." When the Fathers of New England who founded Harvard College inscribed Veritas upon its seal, to which was soon added Christo et Ecclesiæ, "they surely never dreamed," says Mr. Clifford, "that there is an irrepressible conflict between the truths of ethical and physical science."

Passing now to the address of the new President, let us notice the treatment of matters of faith and reason, considered in regard to an educational system, by a man of great general, and of special scientific culture. The President (and he here speaks also of the University) allows no antagonism between literature and science; he makes no distinction. Instruction is not to be specialised—it is to be general, and the University is not concerned with applications of knowledge: "truth and right are above utility in all realms of thought and action." The subject-matter of learning must be augmented, not diminished. In America specially learning must be broadened and invigorated, for it will require many generations before it will bear pruning. "Recent discussions have added pitiful little to the world's stock of wisdom about the staple of education. Who blows, to-day, such a ringing trumpet-call to the study of language as Luther blew? Hardly a significant word has been added in two centuries to Milton's description of the unprofitable way to study languages. Would any young American learn how to profit by travel, that foolish beginning but excellent sequel to education; he can find no apter advice than Bacon's. The practice of England and America is literally centuries behind the precept of the best thinkers upon education." The problem is not what to teach, but how to teach. With an improved system, Mr. Eliot thinks that a man of twenty-five ought to have a good general knowledge of all the main subjects of human knowledge, and a thorough knowledge of the one subject which is to engage his professional after-life. There are special modes of thought belonging to each special branch of learning, and a young man ought to have some actual experience of each

As to the subjects taught in the American universities, Mr. Eliot tells us that the course of study has of late been enriched and enlarged. "The University believes in the thorough study of language. It contends for all languages—Oriental, Greek, Latin, Romance, German, and especially for the mother-tongue; seeing in them all one institution, one history, one means of discipline, one department of learning. . . . The University recognises the natural and physical

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sciences as indispensable branches of education, and has long acted upon this opinion; but . . . . . the prevailing methods of teaching science, the world over, are, on the whole, less intelligent than the methods of teaching language. The University would have scientific studies in school and college, and professional school develop and discipline those powers of the mind by which science has been created and is daily nourished—the powers of observation, the inductive faculty, the sober imagination, the sincere and proportionate judgment." He next speaks of mathematics, of history, of mental, moral, and political philosophy. The latter of these should not be taught with authority, because they are full of disputed matters, and because "exposition, not imposition, of opinions is the professor's part."

The admission—or, as we should say, matriculation—examination at Harvard College is something similar to the first examination in the University of Paris; but, for the first degree in Arts, no less than four years' study are requisite. We have another proof of the difficulty of obtaining this degree in the fact that one-fourth of the total number of students who enter the College fail to take it. Of these four years, the first is devoted to certain fixed subjects, through which all freshmen pass; but, during the other three years, more than half the time is given to subjects chosen by the student from lists. Six studies may be thus chosen for the second year, nine for the third year, and eleven for the fourth year of college life. This so-called "elective system" has been found to work well, and President Eliot proposes to extend it. Harvard possesses among her students men of the most varied conditions in life, and of the most varied means. Many men enter yearly without any resources at all; but, so long as they exhibit aptitude for learning, and are of good character, they are never refused admission on account of their poverty. Every year, a sum of more than 20.000 dollars is expended in helping poor students to complete their university education; and, in addition to this, there are many private grants of money. "No capital," says Mr. Eliot, "earns such interest as personal culture. . . . . The poverty of scholars is of inestimable worth in this money-getting nation. It maintains the true standards of virtue and honour. The poor friars, not the bishops, saved the church."

Harvard College is governed by the Board of Overseers, the Faculties, and the Corporation. During the last three years, the overseers have been chosen by the Alumni, and five are elected each year to serve for six years. Their duty is to inspect the University, and to watch the actions of the President and Fellows. The Corporation makes all appointments, fixes salaries, and acts as Treasurer. It holds all public trusts and grants, and invests all unemployed moneys of the University. It should always be seeking "how safely to make a quarter of a per cent more: a quarter of one per cent means a new Professorship." The President is a member both of the Board of Overseers and of the Corporation, as, also, of all the Faculties. His chief duty is that of supervision; he has, further, to advise the Corporation in the matter of appointments. As regards the teachers: "the Corporation demands of all its teachers that they be grave, reverent, and high-minded; but it leaves them, like their pupils, free." A University is built, not by a sect, but by a nation.

Here, then, we have, in brief, the outlines of the mode of working of a university "intensely American in affection, and intensely democratic in temper." We can scarcely attempt here so large a scope as a comparison of it with our own or foreign universities, for the character of such an institution is always profoundly influenced by the character and conditions of the people for whom it exists. A strict comparison on equal terms hence becomes impossible, and a comparison, without an even balance of existing influences and qualities, unfair. Yet we would presume to say that many of our European universities might, with advantage, adopt some of the regulations of Harvard; and that a reverse interchange would be beneficial is admitted by the New England Cantabs themselves. Harvard University has grown greatly during this century, and we doubt not but that it is destined to play an important part in the culture of the New World. The new President, whose life has been linked with that of the University, whose judgment has been ripened by travel and by residence in Europe, and who possesses a singularly healthy tone of thought, combined with refined intellectual tastes, has been well chosen for the furtherance of this destiny.

Géologie Comparée: Etude Mineralogique du fer Météorique de Deesa. Par M. Stanislas Meunier, Docteur ès Sciences. &c. Paris: F. Savy, 24, Rue Hautefeuille.

This pamphlet is a reprint of a series of articles which have appeared in *Cosmos*. The headings of the chaptess are:—"Description and Chemical Analysis of the Iron of Deesa;" the latter name refers to a locality in the Cordilleras Mountains, in Chili. "Mineralogical Analysis of the Meteoric Mass;" from this portion we learn that the meteorite referred to contains no less than eleven different well-defined mineralogical species. "Comparison of the Deesa Meteorite with Divers Types of Meteorites." "Conclusions Drawn from the Investigation;" this portion of the paper informs us that it is possible to come to some knowledge of the geological age meteorites belong to, since the author states that our globe contains what he terms eruptive meteoric rocks. The Deesa meteorite is stated to be remarkable, because it is the first instance met with of an extra-terrestrial dyke (*filon*). The pamphlet is well printed, and is issued on a better kind of paper than is usual with our courteous French neighbours.

CORRESPONDENCE.

Gmelin's Chemistry.

To the Editor of the Chemical News.

Sir,—It is known, no doubt, to all your readers that the Cavendish Society has been for some years defunct, and that their works are understood to have been handed over to their publisher, Mr. Harrison, of 59, Pall Mall. That gentleman has since issued the two last but one volumes of the translation of "Gmelin's System of Chemistry," which, at the demise of the Society, was incomplete. But the last volume (vol. xviii.), which is to contain the index, is not yet published, nor does there appear any certainty when it will be, if ever.

Yet, in the absence of this index volume, this magnificent work is almost useless to chemists for reference. Two or three years having elapsed without any progress towards our attaining this index being apparent, may I enquire whether Messrs. Harrison have any copyright in this work, and if not, suggest that it would, probably, be worth the while of some other publisher to set vigorously about producing the index to Gmelin.—I am, &c.,

Reference.

January 11, 1870.

Sampling of Cargoes of Phosphatic Raw Materials.

To the Editor of the Chemical News.

Sir,—It has now become a settled practice to fix the price to be paid per ton according to the percentage of tribasic phosphate of lime found by analysis. Samples are usually sent to two chemists, and, for their convenience, sent in fine powder. The seller or his agent suggests that, to procure this powder, the material should be passed through millstones; and some manufacturers are unwise enough to consent to such a vicious practice, which goes far to explain the

well-known fact that, given a certain quantity of material stated to contain a certain percentage of phosphate of lime, you can never obtain, in the manufactured article, the amount of phosphate you had a right to expect by calculation. In the action produced by the process of grinding, great heat is evolved, which heat proceeds from the moisture which is thus, to a certain extent, used up, and disappears; and thus it is not unfrequently found that 1, 2, or 3 per cent of moisture disappears, and the phosphates, consequently, are increased in the analysis. We have long expected that analytical chemists, who must have been well aware of the injustice, would have come forward and proposed a remedy; but they have not done so; and, lest it may be supposed that it is a necessary evil, and there is no cure, we beg to suggest one or two modes by which the injustice can be removed.

1. While the cargo is being discharged, let one weighing in fifty be placed over a kiln or some convenient drying-place, and thus a great portion of the moisture dried off and ascertained. Most manufactories afford convenient means for accomplishing this, which can be done by the sellers and buyers' agents, and during the discharge of the cargo. Suppose 5 per cent of moisture is thus driven off, then the phosphate found in 95 grs. of such sample will represent that which exists in 100 grs of the cargo. There will then be no objection to passing the dried sample through stones. This mode is particularly suitable for wet cargoes; but, in a case where this drying cannot be conveniently accomplished,

No. 2 plan may be adopted, which is either to send rough samples to the chemist or, if, for their convenience, a fine sample is wanted, to send a rough sample with it at the same time, from which the chemist should ascertain the moisture. In all cases, as the moisture resides mostly in the fine part of the cargo, it is desirable to pass the sample lot through a screen, and then, by weighing each separately, to ascertain their respective proportions, and then taking care that the sample for analysis should be made up in the same proportion—say one of fine, and two of rough, as the case may be.

3. There is yet another mode of dealing with the difficulty, and that is for the seller to allow the buyer 1 or 2 per cent, according to the dampness of the cargo, for the privilege and convenience of allowing the whole to be ground under stones.

Here, then, are three methods, each fair to both parties, and vastly preferable, we think, to the unjust system frequently pursued and which often leads to disputes.—We are, &c.,

Spooner & Bailey.

Gmelin's Chemistry.

To the Editor of the Chemical News.

Sir,—In reply to the letter signed "Reference," which appeared in your last number, and for the satisfaction of many persons who are interested in the completion of Gmelin's "Handbook," I beg to be allowed to make the following statement.

About 200 pages of the concluding volume are already translated; but, for the remainder, we have to wait the pleasure of the German editor and publishers, whose movements are not very expeditious. The conclusion was promised last year, but has not yet appeared; when it comes to hand, the translation will be completed with all possible despatch.

The much desired index is in progress, and a considerable portion is already compiled; but its completion must, of course, depend on that of the work itself.—I am, &c.,

Henry Watts.

151, King Henry's Road, N. W.
January 17, 1870.

Presence of Lead in Wine.

To the Editor of the Chemical News.

Sir,—This week's Chemical News contains a paper by Professor Storer, "On the Simultaneous Occurrence of a Soluble Lead Salt, &c., &c., in Sherry Wine." This paper will lead many to believe that the addition of litharge and sulphuric acid to wine is by no means a rare occurrence, and may thus needlessly alarm some, and cast an undeserved slur upon others. I would, therefore, with your permission, make a few remarks on the above paper.

The addition of litharge to wine, for the purpose of removing acidity or for any other purpose, is, I believe, never practised at the present day, if, indeed, it ever was a practice. The belief that such a practice exists is nothing more than an old tradition, kept alive by the occasional finding of lead in some sample of wine.* In most or all of these cases, when properly investigated, the presence of lead may be proved to result from carelessness, and is not due to wilful addition of litharge for purposes of improvement; indeed wine could not be thereby improved. For instance, the wine has been run through leaden pipes; has been filled into bottles cleaned with shot, some of which have stuck in the bottle; or has, in some other similar manner, come into contact with lead, and been impregnated by it.

Again, the presence of small quantities of free sulphuric acid is of very frequent occurrence in sherry, and, in fact, in many other wines. Its presence is easily accounted for without the hypothesis of its addition for the purpose of removing lead. It is now well known that plaster-of-Paris is very frequently added to *must*, and its action on cream of tartar yields tartrate of calcium, sulphate of potassium, and sulphuric acid, part of the latter remaining free if the other salts are not sufficient to neutralise it.

Lastly, the solubility of sulphate of lead in tartrate of ammonium is a well-known fact, and has been long employed in analytical chemistry for the purpose of separating sulphate of lead from sulphide of mercury and sulphur.—I am, &c.,

A. Dupre, Ph.D.

Westminster Hospital,
January 15, 1870.

The Cavendish Society.

To the Editor of the Chemical News.

Sir,—It may be satisfactory to many of the old members of the Cavendish Society to be informed that the Society is not extinct. I was present at the last public meeting, held under the presidency of Mr. Graham, when it was resolved—1. To accept the offer of Messrs. Harrison to relieve the Society from its liabilities, and to complete the translation of "Gmelin's Chemistry," including a full index, on the condition that the Society surrender to Messrs. Harrison the remainders of the works issued by the Society (already printed and published by Messrs. Harrison), and also the right of sale, at a stipulated price, of the volumes required to complete "Gmelin's Chemistry." 2. That the President, Council, and Secretary, hold office until this engagement with Messrs. Harrison be fully carried out.

Mr. Watts has already explained the cause of the delay in the completion of "Gmelin." Subscribers will see that their interests have been cared for by the President and Council. The Council can meet, at any time, with full powers to act. Should such a meeting be necessary, their first duty will be a melancholy one, namely, to elect a new President, and then, having agreed that the engagement with Messrs. Harrison has been fully carried out, to dissolve the Society.

* *Query*. Has the name *sugar* of lead, by which acetate of lead is popularly known, anything to do with this belief in the use of litharge as sweetening matter?

Although a member of the Council, I have no official authority whatever for making the above statement, nor do I know of any means, short of summoning the Council, for procuring such a statement. But as so many inquiries and complaints have been made respecting the present position of this Society, I trust it will not be thought impertinent if I thus supplement Mr. Watts's letter. I am, &c.,

C. Tomlinson.

Highgate, N., Jan. 24, 1870.

Gmelin's Chemistry and Watts's Dictionary.

To the Editor of the Chemical News.

Sir,—Every chemist and possessor of "Gmelin's Chemistry" will, I am sure, in common with myself, be glad to have seen Mr. H. Watts's letter in the last number of the Chemical News, and to hear that there is at last a chance of this very valuable work being completed.

Whilst on this subject, I would refer to Mr. Watts's "Dictionary of Chemistry," and should like to know if there is any probability of the hint being acted upon, which, I believe, you originated at the time this latter work was completed—viz, the annual publication of a supplement which would contain the contributions to chemical science for the year preceding. Such a book is published in Germany, and is a great boon to all chemists; but, with a work like Watts's "Dictionary" as a starting point, the further labours of its eminent compiler, than whom there is no one more competent, would be much more valuable.

I am sure that all my brother chemists would only be too glad to purchase the book at a price which would well remunerate the publishers.

John G. Dale.

Laboratory, Mersey Bank,
Warrington, January 22nd, 1870.

OBITUARY.

A. PAYTON HURLSTONE.

We record, with pain, the death of a valued friend and talented contributor to the Chemical News. Adam Payton Hurlstone, M.R.C.S., M.B., B.Sc., &c., died on the 21st of December, in the 24th year of his age, on board the steamship *Laplace*, on his passage from Brazil, where he had been pursuing his studies in botany, geology, &c; he was buried the same day, at sea. Since leaving Cheltenham Grammar School, Mr. Hurlstone's scientific and medical studies had been pursued at University College, where he distinguished himself by carrying off, at an early age, the highest prizes for which he competed. It is to be feared that his unremitting devotion to study, acting on a frame not naturally robust, sowed the seeds of premature disease; and, with a view of combating unfavourable symptoms, he was advised to try the effect of foreign travel and sea voyages. We had great hopes that his health would, by this means, have been restored, and that he would soon have been enabled to continue that career of usefulness of which his talents gave such ample promise. At one time he was a frequent contributor to the Chemical News, and some of the best reviews and unsigned articles which have ever appeared in these pages were from his pen. His relatives wish to take this opportunity of intimating their great loss to his many scientific friends.

MISCELLANEOUS.

New Food Journal.—We perceive with pleasure that Messrs. J. M. Johnson and Sons, of Castle Street, Holborn, announce their intention of bringing out a new and cheap periodical, called the *Food Journal*, to be devoted entirely to the very important subjects of Food and Public Health. These two great questions are so prominent now-a-days, and embrace so many details of personal interest, that we cannot, even on purely selfish grounds, refuse to listen to them, especially when put before us in any other but a professional and technical guise. The adulteration question will be largely and carefully dealt with, and many of the leading sanitary writers of the day will contribute to the pages of the Journal.

The Troppmann Trial.—One of our correspondents has the kindness to call our attention to a portion of the evidence of Prof. F. Roussin, which we translate. Speaking of the abdominal viscera of the corpse of Jean Kinck, this well-known chemist says—All the viscera, except the stomach and duodenum, are in full state of putrefaction; the internal parietes of the stomach exhibit a slaty colour, which had not penetrated into the tissue of the organ itself. On more minute examination being made, it was found that there were two distinct colours—one black, due to sulphuret of iron, and one blue, distinctly due to Prussian blue; the latter was detected with certainty, and this was sufficient evidence of the previous presence of hydrocyanic acid. The liquids of the stomach contain, moreover, a very large proportion of an alkaline sulphate, and in such large quantity as it never otherwise occurs in that organ. The Professor accounts for the presence of the three substances named by the rudimentary mode employed by Troppmann for the manufacture of hydrocyanic acid. The method is described as follows:—The convict used two retorts—one smaller, the other larger—the latter serving as receiving condenser. He used ferrocyanide of potassium and dilute sulphuric acid to prepare the hydrocyanic acid from, but was unable to prevent the formation of incrustations of sulphate of potassa and sulphate of iron; hence, irregularity ensued in the boiling of the liquid, and, along with the hydrocyanic acid, sulphate of potassa and sulphate of iron spirted over. In addition to these impurities, there was formed a white substance, which turns blue on exposure to air; and that substance has also been found in the stomach. Some of the Prussian blue found in Kinck's stomach was handed round to the jury at the trial.

The Royal Mint.—Mr. W. Chandler Roberts, F.C.S., As.R.S.M., has been appointed chemist to the Mint. We call attention to this with the greater pleasure because it is a new chemical appointment in connection with the Government. The laboratory will, we believe, be partly devoted to research—the first laboratory of this sort established by the Government. Mr. Roberts was for some years assistant to the late Professor Graham, and associated with him in hydrogenium researches; we, therefore, hope that Mr. Roberts will continue his experiments on this subject, and that this new recognition of science on the part of the Government may lead to many useful discoveries.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the month, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Revue Hebdomadaire de Chimie, December 16, 1869.

Aniline Blue.—M. Blumer-Zweifel.—When either the tartrate or hydrochlorate of aniline is brought under the influence of oxidising substances, it produces on tissues an

intensely black colour; by a somewhat analogous process, the author obtains a blue which is stated to be as good as indigo blue. For printing, 100 grms. of dry starch are mixed with a litre of boiling water, to which is added 40 grms. of chlorate of potassa, from 3 to 4 grms. of sulphate of iron, 10 grms. of chloride of ammonium, and, after this mixture is cold, 60 grms. of the aniline salt.

Vesuvine.—M. Knosp.—Under this name, the author has brought into commerce a dye material belonging to the class of aniline dyes; but no further particulars are mentioned, as regards the preparation, or mode of obtaining the dye, which is reported to be sold in the state of paste and powder. This dye yields shades of bright, as well as deep orange and bright brown, and is suitable for dyeing silk, wool, and cotton; but this latter fabric has to undergo a series of mordanting processes before it is in proper state to receive the dye.

Carbon-Japanis.—Under this appellation there has recently come into use, for the purpose of paving, instead of asphalte, a mixture of coal-tar, and some chemicals not specified, and fine dry sand; this is stated to yield a very sound, hard, durable, and, at the same time, very cheap pavement.

December 23, 1869.

Manufacture of Sulphide of Carbon.—M. Contet.—As a proof of the greatly improved mode of manufacture of this substance and its very extensive use, the author begins by stating that, in 1840, the kilo. of rectified sulphide of carbon cost 50 francs (£2); in 1848, M. Deiss manufactured it and sold it at 8 francs per kilo., and now it may be had wholesale at 50 centimes the same quantity. The apparatus now in use consists of vertical retorts made of the same kind of clay as is in use for glass-pots; these retorts are 1·8 metre high by 0·50 internal diameter, they are lined internally with a glaze composed of 130 parts of flint glass, 20 parts of carbonate of soda, and 12 parts of boracic acid fused together, and next pulverised and painted on the inside of the retorts with gum water (at the first heating of the retorts this mixture yields a glaze which entirely closes the pores of the material, thus preventing escape of vapours and gases); four of these retorts are set in one oven made of brickwork, and are heated by a properly constructed furnace; the retorts are provided with the necessary tubes for the abduction of the vapours of the sulphide of carbon, and the introduction of the charges of sulphur and charcoal; the operation once commenced is continuous, since the retorts last for at least six months; the consumption of sulphur per retort amounts to 125 kilos. in 24 hours, introduced in charges of 155 grms. each, every three minutes time; the vapours of the sulphide of carbon are collected and condensed in vessels made of zinc or sheet-iron, and shaped like flattened down casks, and entirely covered over with cold water constantly refreshed, while the contrivance is so arranged as to keep the sulphide under water also (its specific gravity is 1·265, and its boiling point 45°). The most suitable temperature for this manufacture is bright red heat; the raw liquid obtained has to be redistilled, and this operation is conducted in large iron vessels, which contain some 5000 kilos. at the same time and communicate with six worm condensers; steam is used for heating by means of a serpentine-coiled set of pipes, and the liquid is heated to 48°; near the end of the distillation the temperature is raised to 100°, in order to drive off a raw product containing very much sulphur dissolved; in the distillatory apparatus some sulphur remains; which is removed and again applied; it appears that this industry has become very extended and is carried on with great success in France. This number contains the first portion of an interesting paper on the

Analysis of Several Different Kinds of Extracts of Meat.—M. Lebaique.—Which we shall leave for the present and abstract only when it is quite finished.

Lighting the Numbers of Street Doors at Nights.—M. Mène states that the researches of a chemist have resulted in the production of a fluid which is painted on the numbers and causes the same to shine and be perfectly visible, even in very dark nights; the process, about the nature of which nothing further is said, is stated to be simple, inexpensive, and not dangerous or injurious in any way; experiments made on the large scale have given satisfactory results.

Annalen der Physik und Chemie, von Poggendorff, No. 11, 1869.

This number contains the following original papers:—

Researches on Mica and Minerals Associated therewith.—Dr. Bauer.

Validity of the Law of Ohm for Electrolytes and a Numerical Determination of the Resistance to Conduction of Dilute Sulphuric Acid by Alternating Currents.—MM. Kohlrausch and Nippoldt.—The concluding portion of a lengthy essay.

Studies on the Oxygen Compounds of the Halogens.—M. Kaemmerer.—In the introduction to this paper, the author suggests an alteration of the nomenclature for the following compounds in the sense thereby respectively expressed, the name now in use being between brackets:—Cl, chlorine; ClH, chloric acid (chlorsäure) (hydrochloric acid); ClHO, oxychloric acid (hypochlorous acid); $ClHO_2$, dioxychloric acid (chlorous acid); $ClHO_3$, trioxychloric acid (chloric acid); $ClHO_4$, tetroxychloric acid (perchloric acid). The paper then treats of trioxybromic acid (which was prepared by the author in pure state from trioxybromate of silver) and its decomposition by means of bromine. This acid was proved to form a definite hydrate—

$$HBrO_3+7H_2O.$$

Trioxychloric acid forms a definite hydrate—$HClO_3+7H_2O$. Sp. gr. at 14°·2=1·282. When this hydrate is left standing *in vacuo* over sulphuric acid, the substance becomes more concentrated, and a momentary evolution of much gas takes place. This concentrated acid led to the formula $2HClO_3+9H_2O$. Trioxyiodic acid forms a hydrate, $2HIO_3+9H_2O$. Sp. gr. at 13°, 2·1269. Pure, solid, and crystalline anhydrous trioxyiodic acid; sp. gr. at 9°, 4·7987.

Comparative Scale for Spectra.—M. Weinhold.—The subject is entirely treated algebraically.

Experiments on Boiling.—M. Krebs.—The author investigates in this portion of his paper, and illustrates, by diagrams and descriptions of experiments, some of the less well-known and defined causes of steam-boiler explosions.

Mineralogical Communications.—M. G. Vom Rath.—This is the eighth part of a lengthy monograph, chiefly of crystallographico-mineralogical interest. Among the recent chemical analyses it contains, we quote:—*Oligoklase*, from Vesuvius. In 100 parts:—Si, 29·38; Al, 12·48; Ca, 2·06; K, 2·21; Na, 5·51; O, 47·06. *Andesin.* In 100 parts:—Na, 11·36; Al, 13·54; Si, 27·67; O, 47·43.

Lightning without Thunder.—T. Hoh.—The author states that the phenomenon seen by him at Bamberg (Bavaria) during the night of the 26th of July last was altogether distinct from the so-called *Wetterleuchten* (sheet lightning), and that, although quite close to him, he did not perceive the least sound or report, which follows sharp and well-defined lightning. There was no wind, and the night very quiet. Bamberg only contains a population of about 26,000; and, since the phenomenon was seen about midnight, there was no noise to prevent even thunder at a distance to be heard.

Journal für Praktische Chemie, No. 13, 1869.

This number opens with a brief obituary of the founder of this periodical, Otto Linné Erdmann, M.D., Ph.D., born at Dresden, April 11th, 1804, and who died on the 9th of October last. The deceased was Professor of Chemistry at

Leipzig, and founder of this periodical in 1828. His three chief co-editors (Messrs. Schweigger-Peidel, Marchand, and Werther) all died before him. Dr. Erdmann's name is connected with many valuable contributions to science.

The original papers are the following:—

Derivatives of Propan (Propylhydride).—No author's name.—By means of a rather lengthy process, the author obtained a body, $C_6H_{12}O_2$; but how this substance originated could not be made out. The main conclusion derived from the results of the experiments is that the general method to bring secondary alcohols to primary is as follows:—The iodine of the secondary iodides is displaced by hydrogen in the nascent state. The hydrocarbon so generated is acted upon by chlorine, whereby primary chlorides are formed. When propan is chlorinated, chloride of propylen, $CH_3-CHCl-CH_2Cl$, is formed. This, the author states, could hereby be expected, since, when ethan, C_2H_6, is chlorinated, chloride of ethylen, CH_3-CHCl_2, is formed.

Pigment Contained in Yellow Berries.—No author's name.—The colouring matter is insoluble in water. It is named rhamnegin. Formula, $C_{24}H_{32}O_{14}3H_2O$. When acted upon by sulphuric acid, it is split up into rhamnetin and sugar, rhamnetin, $C_{12}H_{16}O_5$, and $2(C_6H_{14}O_6)$. When rhamnegin is heated to 140° alone with anhydrous acetic acid, the result is the formation of a substance insoluble in water—

$$C_{24}H_{26}(C_2H_3O)O_{14};$$

while rhamnetin, treated in the same manner, yields a solid substance soluble in alcohol—$C_{12}H_8(C_2H_3O)_3O_5$.

New Volatile and Saccharine Substance from the Caoutchouc of Gaboon.—M. Girard.—The author finds, in the caoutchouc imported from the French settlement of Gaboon (West Coast of Africa), a substance which he calls *Dambonite*. It is a white-coloured, solid body. Taste sweet; very soluble in water; difficultly so in absolute alcohol; fusca at 190°; and may be sublimed at 200° to 210° without decomposition. In its crystalline state, its formula is $C_6H_8O_6$. When submitted to the action of fuming hydriodic acid, it is split up into *Dambose* and iodide of methyl; $C_6H_8O_6 + HI = C_6H_8O_6 + C_2H_3I$. Dambose is an anhydrous glucose, capable of crystallisation, insoluble in absolute alcohol.

On Rufigallic Acid.—M. Löwe.—After referring to the labours of M. Robiquet and others on this subject, the author states that, when rufigallic acid is pure, it is insoluble in water, either hot or cold, difficultly soluble in ether and alcohol, and exhibiting a red-brown powder not unlike amorphous phosphorus. Average composition in 100 parts:—C, 54·449; H, 2·697; the rest being O. Formula, $C_{26}H_8O_{12}$.

No. 14, 1869.

This number contains the following original papers:—

Contribution to the Qualitative Analysis and Detection of Dyes and Colours Imparted to Textile Fibres.—M. Stein.—This paper is to be considered as an introduction to an essay the author intends to publish on this subject, which is, indeed, a far more difficult one than is generally believed. The author gives some instances, stating that not only the material of the dye, but the duration of exposure to the dye-bath, mordants applied, the mode of cleansing (*average*), all concur to influence the qualitative detection of even one and the same dye material; as a general rule all dyes fixed by means of tin mordants are faster than those fixed by means of alumina mordants, and all dyes fixed without any mordant at all are more or less easily dissolved from the textile fibres. This portion of the paper treats further on blue dyes, of which, under the heading of simple (*einfach*) four kinds are enumerated, viz., (1) Indigo applied in two different ways, so-called "vat blue" and "Saxony blue;" (2) Prussian blue or cyanogen blue; (3) Blue from various dye woods; (4) Aniline blue. Mixed blue dyes.—The different qualitative tests and the mode of their application are given at full length, of which the following is a condensed abstract:—I. Heat the material to be tested with alcohol of 80 per cent and a few drops of hydrochloric acid. A. The material is reddened, and yields a red liquor. Blue from dye woods.—B. The material retains its blue colour, the fluid becomes blue coloured: (1) Aniline blue; (2) Saxony blue. C. The material remains unchanged; liquor not coloured: (1) Vat blue; (2) Cyanogen blue. II. Further treatment of the materials sub B and C. B. The fabric is tested with strong sulphuric acid; no change occurring indicates Saxony blue. When the colour changes to brownish yellow or brownish red, aniline blue is present. C. Heat with a solution of soda; no change of colour occurring indicates vat blue. When, on the other hand, this reagent causes either complete discolouration or turning to yellow or brown, cyanogen blue is indicated. It should be observed that a series of confirmatory tests are required and given at length, but space forbids to enter into further particulars.

Meteoric Iron Fallen on the Collina di Brianza (Milanese Territory).—Dr. Hausofer.—The author has made a careful analysis of a piece of this very large meteorite, about the origin of which some doubt has existed. The specific gravity of this material is 7·596; it does not contain sulphur or chromium, and was found to consist, in 100 parts—of iron, 91·1; nickel, 7·7; phosphorus, 0·3; cobalt, 0·2; and traces of carbon.

Meteorite Found near Cranbourne, Australia.—Dr. Hausofer.—Specific gravity, 3·744; contains, in 100 parts—insoluble silicates, 4·1; silica, 2·3; alumina, 1·5; lime, 1·8; phosphoric acid, 1·4; protoxide of iron, 71·1; protoxide of nickel, 3·1; water, 13·7. The hardness of this substance is about the same as that of felspar.

Action of Chloro-Chromic Acid (Chromsaurechlorid) Upon Benzol.—Dr. Carstanjen.—The author first reviews the labours of M. Cariua and others to obtain the direct oxidation of benzol, and then states that it occurred to him that chloro-chromic acid might be used for this purpose. The action of that substance upon benzol is, however, so violent that the chloride aforesaid cannot be used undiluted; as a diluent, liquid glacial acetic acid is used, and in this manner there is obtained, after proper purification, a substance, trichlorchinon, $C_6HCl_3O_2$. This material is crystalline, soluble in boiling alcohol, and its origin from benzol is explained by the following formula:—$4(CrO_2Cl_2) + C_6H_6 = C_6HCl_3O_2 + 2Cr_2O_3 + 5HCl$. When chlorochromic acid contains any free chlorine, there is also formed some tetrachlorchinon and a peculiar heavy oily substance.

Combination of Tantalum and Niobium.—M. Rammelsberg.—The author has undertaken this very laborious research in order to test the correctness of the labours of Messrs. Blomstrand and Marignac on this subject, and also to vindicate the correctness of the researches of the late M. H. Rose; the headings of the chapters of this monograph are: tantalum, atomic weight of tantalum, chloride of tantalum, bromide and iodide of tantalum, fluorides and double fluorides of tantalum, tantalic acid, salts of tantalic acid, lower oxides of tantalum, nitride of tantalum; this paper is to be continued.

On Chrysophanic Acid.—Dr. Rochleder.—After referring at some length to the labours of many chemists, as well as those made by himself on this subject some years ago, the author enters into a discussion on the statements made by MM. Graebe and Liebermann respecting the composition of chrysophanic acid, and then says, that he has taken the trouble to prepare this acid in pure state from rheine as prepared by Dr. Marquardt at Bonn; this substance consists mainly of chrysophanic acid, emodine, and impurities; the composition of pure emodine dried at 100° is, in 100 parts, C, 65·75; H, 4·29; O, 30·18; formula: $C_{40}H_{26}O_{13}$;

the formula which Messrs. Graebe and Liebermann give for chrysophanic acid, viz, $C_{14}H_8O_4$, cannot, according to the author of this paper, be the correct one, and this the less so, as no less than six different chemists have found for the formulæ of this substance, prepared from different sources and at various periods, the formula, $C_{56}H_{42}O_{17}=4(C_{14}H_{10}O_4)+H_2O$, because the H_2O of crystallisation is only driven off at 115°; it should be kept in view that emodine is very difficult to separate from chrysophanic acid, and M. Rochleder suspects that the statements of Messrs. Graebe and Liebermann about the action of pulverized zinc upon chrysophanic acid are vitiated by the presence of emodine in the acid used for these experiments.

On Toluylendiamine.—M. Koch.—This substance, a bye product of the manufacture of aniline, is readily and rather violently acted upon by anhydrous acetic acid, the result being the formation of diacetyltoluyldiamine:—

$$\underbrace{C_7H_4\left\{\begin{matrix}NH_2\\NH_2\end{matrix}\right.}_{\text{toluyl-diamine.}}+\underbrace{C_2H_3O\left.\begin{matrix}\\\\\end{matrix}\right\}}_{\text{anhydrous acetic acid.}}O=H_2O+\underbrace{C_7H_4\left\{\begin{matrix}NHC_2H_3O\\NHC_2H_3O\end{matrix}\right.}_{\text{diacetyl-toluylendiamin.}}$$

This latter compound yields, on being heated to 150° with 1 eq. of carbonate of soda, an acetyl, and is thereby converted into monoacetyldiamine; the diacetyl compound is, by the addition of bromine, converted into monobromodiacetyltoluylendiamine,

$$\left(C_7H_3Br_7\left\{\begin{matrix}NHC_2H_3O\\NHC_2H_3O\end{matrix}\right.\right)$$

a solid substance crystallising in needle-shaped crystals; when this compound is heated to 130° along with an excess of caustic potassa solution it is converted into monobromoacetyltoluylendiamine.

Les Mondes, December 23, 1869.

Estimation of the Value of Sugars for Commercial Purposes.—M. Méhay.—The author proposes that the brokers should supply standard samples of refined sugar, which should be considered as pure, for all commercial purposes, and that every assay, of any kind of sugar, whether made by means of the optical saccharimeter or by the Frommherz-Barreswil process, should be compared with an assay of the standard sample made at the same time. The samples of raw sugar marked from No. 1 to 21, adopted by the Netherlands' Society for Trade and Commerce, have been found, by repeated assays, to represent very accurately the value, and each to contain, according to the specific number, the percentage of pure sugar found therein by rigorous analytical methods; and with these samples properly marked and guaranteed genuine any analyst can be supplied by brokers. On the Continent, raw sugars are generally denominated No. so and so, by which the different qualities are readily discriminated, bought, and sold.

Falling Stars.—The Rev. Father Denza, S.J.—A very interesting and extensive account of observations made at nineteen different places in Italy, from Palermo to Moncalieri and Milano, giving for every locality the number of meteorites seen and observed at observatories during a given time.

Obituary.—The well-known scientific chemist, Stephane Robinet, who was born at Paris on the 6th of December, 1796, died at that city on the 3rd of December, last. The deceased is especially known for his zeal in analysing the natural waters of France, and for his excellent hydrographical works.

Cosmos, December 25, 1869.

Permeability of Caoutchouc Tubes.—M. Jouant.—The author states that, from a series of experiments he has made, the following conclusions may be drawn:—A vulcanised caoutchouc tube of 1·2 m.m. thickness, and having a surface of 33·60 sq. m.m., loses, in three days, by diffusion, 21·3 per cent of hydrogen, while 11·2 per cent of air has at the same time entered. That the non-vulcanised caoutchouc tubing is by far less permeable for gases is proved by the following facts:—A tube of the last-named substance, having 50·00 sq. m.m. surface, has been submitted to the same experiment during twenty-eight days, and lost during that time, by diffusion, 22·6 per cent of hydrogen, while only 5·6 per cent of atmospheric air entered the apparatus, which was arranged precisely alike for both experiments, and so constructed as to indicate any change of pressure going on internally by means of manometer tubes. The permeability of caoutchouc for gases is a well-established fact, and a consequence of its peculiar structure.

Comptes Rendus des Séances de l'Académie des Sciences, December 27, 1869.

This number opens with an eulogium on—

The Annuaire du Bureau des Longitudes for 1870.—M. H. St. Claire-Deville.—The speaker observes that this very useful periodical has, in consequence of its various and comprehensive scientific data and memoranda, become indispensable to the scientific chemist; and the well-known *savant* desires to see its use greatly extended. As is known (at least to some of our readers), the periodical alluded to owes its origin to the eminent men who were foremost among the authors of the first French Republic, and who founded the Ecole Polytechnique.

Acclimatisation of the Cinchona Trees in the Island of Réunion.—M. Morin.—The author, encouraged by the success obtained in the British and Netherlands' Colonies, has induced a friend residing in the above-named island, a French possession, to try the acclimatisation of this important tree; and the result is such as to foster the reasonable expectation that the Island of Réunion will, within a few years, also become a *Cortex*-producing country.

Presence of Soda and Potassa in Divers Parts of Plants.—M. Pierre.—In reply to some objections made by M. Peligot to the author's statements on this subject, he says—I admit the presence of a small quantity of soda as a normal constituent of plants, but its quantity decreases permanently, whereas the quantity of potassa increases constantly during the life of plants. The increase of the latter base follows the same rule as the increase of phosphorus, nitrogen, &c.; and while potassa is combined in a manner which renders it a very fixed mineral, soda is easily removed by a simple treatment with distilled water.

Artificial Production of some Precious Stones.—M. Gaudin.—While presenting to the Museum of the Academy an exquisite collection of artificially-prepared precious stones, the author communicates some curious observations on the effect of a powerful oxyhydrogen blowpipe blast. Alumina, by itself, cannot serve for obtaining precious stones, owing to the tendency of this earth to devitrify again. It does not become pasty before fusing, but liquefies at once, and is as fluid as water; and next volatilises as if it were camphor. In order to render alumina viscous, quartz has to be added; but that impairs the crystallisation, and also the hardness. The colouration of the stones is another difficulty, since the enormously high temperature of the oxyhydrogen blast acts upon several substances, such as compounds of gold, silver, palladium, and other metals, in a manner quite different from that of a furnace fire. Copper is a protean substance in this aspect, and, by dexterous manipulations, may be used to produce many tints of colour. Curiously enough, manganese and nickel yield, at this high temperature, an orange-yellow colouration; and chromium, exposed to the reducing flame, gives a sky-blue, and in the oxidising flame, a deep green, which is smoked (*enfumé*), as it were, and has not even a remote resemblance to emerald green. This colour can only be obtained by a special and very well directed oxidising manipulation from oxide of copper.

Rendering Commercial Sulphide of Carbon Inodorous.—M. Cloez.—The author states that, when sulphide of carbon is left for twenty-four hours in contact with half per cent of its weight of finely-powdered corrosive sublimate, care being taken to shake or stir up this mixture, the mercurial compound combines with the substances which are the cause of the fœtid odour of this substance, and an insoluble compound is deposited. The liquid is carefully decanted, and, after 0·02 of its weight of a pure inodorous fat has been added (no reason is given for this addition), the sulphide is redistilled with care by the heat of a water-bath. The sulphide thus obtained exhibits an ethereal odour, and is eminently suitable for the extraction of oils, fats, &c., from various substances, since, on evaporation of the purified sulphide, these matters are obtained in as fresh and pure a state as if the oils had been obtained by pressure.

Chemistry of Copper.—Dr. Sterry Hunt.—The author has instituted a comparative research on protochloride of copper, Cu_2Cl, and chloride of silver. The properties of these salts agree in so many aspects, according to the author, that he feels inclined to place these metals, copper and silver, in the same class.

General Researches on the Modifications which Minerals Undergo when Submitted to the Action of Saline Solutions.—M. Terreil.—The author describes, at great length, in this paper, the action of a solution of monosulphide of sodium (1 part of dry salt in 10 of water) upon a great number of metallic sulphides, selenides, tellurides, and antimoniosulphides; the conclusion arrived at is that monosulphide of sodium may advantageously be applied, not only for the separation, but even the quantitative determination of some metals existing in minerals in the state of sulphides.

Preparation and Properties of Hydrate of Chloral.—M. Personne.—Referring to the labours of MM. Roussin and Dumas on this subject, the author, after repeating, with great care, the experiments of the last-named eminent *savant*, concludes that the substance obtained by M. Roussin (a sample of which, given by the latter to the author, had been analysed by him) is not pure hydrate of chloral, but a trichlorinated acetate, of the formula $C_4HCl_3.C_4H_6O_2$. The author also observes that, whereas 100 parts of absolute alcohol yielded, by M. Roussin's mode of preparation, only 80 per cent of substance, he, on following exactly M. Dumas's method, obtained 185 per cent of a real and pure hydrate of choral.

Separation of Ordinary from Inverted Sugar.—M. Lubrunfaut.—The author, continuing his altercations and discussions with M. Maumené on this matter, describes in this paper, at great length, his experiments of separating, by means of lime, ordinary sugar from inverted sugar.

Simultaneous Action of the Intra-Pilair Current and Nascent Hydrogen upon Organic Acids.—M. Royer.—Under the influence of nascent hydrogen and *intra-pilair* action, the author has converted oxalic acid into formic acid.

Metamorphosis and Migrations of the Immediate Principles in Herbaceous Plants.—M. Dehérain.—This lengthy memoir contains the records of an interesting series of researches proving the curious changes which substances—as, for instance, sugar, albumen, gum, &c.—undergo in the living plants, and especially in the cereals.

Detection of Cyanhydric Acid and Cyanides in Cases of Poisoning.—M. Bonjean.—A foot note added to this title of a paper, and signed "D.," informs the reader that this paper could not be printed for want of sufficient experimental details.

Heavy Flint-Glass for Optical Purposes.—M. Feil.—This gentleman sends in samples of perfectly homogeneous glass free from any bubbles or defects, and in masses weighing from 25 to 35 kilos. The process whereby this is obtained is not explained; but the statement is made that the crucibles having been protected from the effects of the lead, a heavier glass even than Faraday's can be made. The maker sends, also, a set of samples of beautifully-made artificial precious stones, not mere specks, but of good size. The mode of manufacture applied to these gems will, according to the author's statement, give interesting results for the study of some optical phenomena. The aluminates of lime, of baryta and lime, of lead and of bismuth, are proposed for flint-glass; and the aluminates of magnesia and the silicates of magnesia and alumina for crown-glass.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 18, 1869.

At the ordinary meeting of this Society, held on the 22nd of November last, under the presidency of Dr. A. W. Hofmann, the following papers were read:—

Lecture Experiment to Show the Increase of Weight Caused by Combustion.—Dr. Kolbe.—Since the value of this paper rests entirely upon the woodcut annexed to it, describing the very ingenious apparatus contrived by the author, we only mention the title.

Carbonate of Phenol.—M. Kempf.—When three parts of phenol and two of fuid phosgen are heated to about 150°, and the contents of the tube afterwards treated with a dilute solution of caustic soda, a solid substance is obtained which crystallises from its alcoholic solution in white silky looking needle-shaped crystals. The formula of this substance is $C_{13}H_{10}O_3$; it is insoluble in water, readily soluble in alcohol and ether, fuses at 78°, and can be sublimed. When treated with concentrated caustic soda solution, it yields carbonate of soda and phenyloxyd-soda; its formula, as carbonate of phenol, is $(C_6H_5)_2O_2(CO)$.

Action of Chloro-chromic Acid (Chromsaure-chlorid) upon the Aromatic Hydrocarbons.—M. Carstenjen.—Chloro-chromic acid, CrO_2Cl_2, acts, when pure, with so great violence upon most organic substances, that deflagration ensues. The author has found that glacial acetic acid is the best diluent, and with such a solution he has investigated its action upon the following substances:—*Benzol.** *Naphthalin* yields a compound, $C_{10}H_4Cl_2O_2$, fusing at 188°, and soluble only in boiling alcohol; it is a bichloronaphthochinon, and is derived from naphthalin according to the following formula:—

$$4CrO_2Cl_2 + C_{10}H_8 = C_{10}H_4Cl_2O_2 + 2Cr_2O_3 + 4HCl + 2Cl.$$

Anthracen yields bichloronaphtochinon and anthrachinon, free from chlorine; formula, $C_{14}H_8O_2$. *Toluol* yields benzoic acid and rather complex results, which are formulated thus:—

$$C_6H_5.CH_3 + 2CrO_2Cl_2 = C_6H_5.COCl + 3HCl + Cr_2O_3.$$

The $C_6H_5.COCl$ acts further upon the glacial acetic acid, in the following manner:—

$$C_6H_5.COCl + CH_3.COOH = \left\{ \begin{matrix} C_6H_5.CO \\ CH_3.CO \end{matrix} \right\} O + HCl,$$

and the mixture of *anhydrous acids* yields, with H_2O, benzoic acid and acetic acid. With xylol, the final result of the reaction is an acid—a solid substance fusing at 173°, and of the composition of toluylic acid—and besides, also, terephthalic acid. Pure mesitylen prepared from acetone is almost insoluble in glacial acetic acid; the action of chloro-chromic acid is consequently very violent, and great caution is required in managing this experiment. The result is the formation of mesitylenic acid.

Contribution to the History of the Sulphocyanides of the Alcohol Radicals.—M. Henry.—This paper is divided into the following sections:—Action of iodide of cyanogen upon mercuro-mercaptan, $(C_2H_5)_2HgS_2$; trisulphocyanallyl, $C_3H_5(CNS)_3$; sulpho-cyanide of benzyl, or methyl-benzol, $C_6H_5—CH_2CNS$; nitro-sulphocyanide of benzyl, $C_7H_6(NO_2)CNS$.

* The author's paper on this subject, in the *Journal fur Praktische Chemie*, No. 14, 1869, having been abstracted by us, we pass this portion over in silence.

Direct Combination of Chloride of Phosphorus (PCl_3) with Sulphur.—M. Henry.—The author says:—Dr. Odling states, in his excellent "Manual of Chemistry" (vol. i., p. 287), that oxygen and chloride of phosphorus combine directly at the boiling-point of the chloride. Acting upon this hint, the author tried whether sulphur would act in the same manner, and yield $PSCl_3$. Very pure chloride of phosphorus, boiling to 78°, was heated to 130°, along with pulverised sulphur, in a sealed tube; the sulphur disappeared. On being submitted to distillation, the fluid came all over at 120°, and the distillate, a colourless fluid exhibiting a sharp smell, proved to be the compound $PSCl_3$.

Wax of Corn-Straw.—M. Radziszewski.—After referring to the researches on the subject of the wax of the *Gramineæ*, made by Dr. G. J. Mulder, M. Dumas, and others, the author states that he has found a waxy substance in the straw of the corn species. This substance is insoluble in water and solutions of caustic alkalies; soluble in boiling alcohol, ether, and sulphide of carbon; fuses at 42°; boils, without decomposition, at 300°; and sublimes at 303°. This substance has, therefore, some analogy with the *cérosie* from sugar-cane. The author states that the sample investigated by him was given him by M. Naeyer, paper manufacturer at Willebroeck lez Malines, Belgium, who appears to have first obtained this material while converting straw into pulp.

On Mercurodiphenyl.—M. Otto.—The author refers back to a paper on this subject by him and M. Dreher (see Chemical News, vol. xx., p. 285; *Ann. Repr. Feb.* '70, *page* 103), and explains, in this present paper, his views, dissenting from some statements made by his co-partner. The paper is not suited for abstraction.

Hydrate of Bromal, and its Action upon the Animal Organism.—M. Steinauer.—The author prepares the hydrate of bromal by causing a current of carbonic acid, saturated with vapours of bromine, to pass into alcohol. The hydrate of bromal thus obtained in large crystals was purified by re-crystallisation, and then used for experimenting with upon animals.

Action of Iodide on Thiobenzamide.—Dr. Hofmann.—When, to a cold saturated alcoholic solution of this benzamide—

$$\left.\begin{matrix} C_7H_5S \\ H \\ H \end{matrix}\right\} N,$$

an alcoholic solution of iodine is added, the latter soon becomes decoloured, and sulphur is precipitated; when iodine is added in slight excess, the liquid, after having been decanted from the free sulphur it contains suspended, becomes a thick magma on the addition of water. By washing with the latter, the hydriodic acid is removed; and by re-solution and repeated re-crystallisation from boiling alcohol, a solid snow-white substance is obtained, fusing at 90°, and subliming, without decomposition, at a high temperature; this substance is also soluble in ether, chloroform, and benzol, and the author considered he had to deal with a compound freed from sulphur, since even delicate tests failed to indicate its presence. When, however, the vapour of this substance is passed over a red-hot mixture of pure nitrate of potassa and carbonate of soda the presence of sulphur is ascertained without difficulty. Elementary organic analysis of this substance led to the formula $C_{14}H_{16}N_2S$, and its formation is expressed by the following equation:—

$$2C_7H_7NS+2H=C_{14}H_{16}N_2S+4HH+S.$$

Chlorine, bromine, and moderately-dilute nitric acid act in the same manner upon thiobenzamide. The author states that the new compound just alluded to exhibits a most remarkable stability, and a stolid insensibility against the action of even rather strong reagents and rough treatment. Acids, even at boiling-point and in sealed tubes, do not affect this material, and the action of alkalies is very gradual and slow; by hydrogen, *in statu nascendi*, it is converted into a base, the hydrochlorate of which is formulated by $C_{14}H_{14}N_2,HCl$; and the composition of the platinum salt is $2(C_{14}H_{14}N_2,HCl)PtCl_4$.

Under the title of "Correspondence," this number contains:—

Review of the Labours of the Chemistry Section of the Late Meeting of German Physicists and Natural Philosophers at Inspruck.—Dr. Gunning read an interesting paper on the use of perchloride of iron for the purification of potable waters.—Prof. Barth spoke on the isomeric modifications of toluolsulpho acid and its decomposition by fusing caustic potassa. The chief point of interest, as regards this matter, is that the author has succeeded in obtaining, from crude toluolsulpho acid, certainly two, and probably three, quite distinct modifications, as exhibited by the difference of the potassa salts of the same.—Prof. Kekulé spoke on the constitution of salts.—Dr. Marquart called attention to the action of perfectly neutral solutions of nitrate of strontia upon wrought-iron vessels used to evaporate that liquid, the consequence of which is the cracking and tearing-up of the metal.—Dr. Batka read a paper on tea, and called attention to the great discrepancies of the analysis of that substance. In the discussion which followed, Prof. Hlasiwetz observed that the quantities of the general principles of plants vary to such an extent, and are so dependent upon the conditions under which plants are grown, that the quantitative estimations thereof are of very little value.

The St. Petersburg correspondent writes—"At the meeting of the Chemical Society held on the 6th of November, O. S. (1869), M. Morkownikoff stated—When any alcohol gives off the elements of water, or when its haloid anhydride gives off a haloid hydrogen, there is simultaneously given off one atom of hydrogen, which is combined with an atom of carbon. By direct addition to unsymmetrically-constituted hydrocarbons, C_nH_{2n}, of the elements of H_2O and HX, the latter are so divided that the hydroxyl or haloid combines with that atom of carbon with which the smallest number of hydrogen atoms are combined. According to this view, normal butyl-alcohol ought to yield a butylen, $CH_3-CH_2-CH=CH_2$, and with HI, the iodanhydride of the secondary pseudo-butylalcohol of Luynes; and the isobutylalcohol must yield the tertiary butylalcohol of Butlerow—

$$\begin{matrix} CH\left\{\begin{matrix} CH_3 \\ CH_3 \end{matrix}\right. \\ | \\ CH_2.OH \end{matrix} \text{ should give } \begin{matrix} C\left\{\begin{matrix} CH_2 \\ CH_3 \end{matrix}\right. \\ \| \\ CH_2 \end{matrix} \text{ and } \begin{matrix} CH\left\{\begin{matrix} CH_2 \\ CH_3 \\ CH_3 \end{matrix}\right. \end{matrix}$$

The experimental researches on this subject, instituted with the isobutylalcohol of fermentation, fully proved the correctness of these views, which are confirmed by M. Butlerow, who has been experimenting in the same direction. M. Gustavson stated that, while heating boracic acid with pentachloride of phosphorus in sealed tubes to 140°, chloride of boron, $BeCl_3$, is readily obtained. Upon causing nitric acid to act upon acetoluide, MM. Beilstein and Kuhlberg have obtained mono- and dinitro-acettoluide. The former yields, with caustic potassa, orthonitrotoluidine; this substance differs from the paranitrotoluidine (as obtained from dinitrotoluol) by its fusing-point, 114°, and by not being capable of combining with acids. M. Wroblewsky has prepared, from chlorotoluol boiling at 156°—160°, a nitrochlorotoluol boiling at between 242° and 255°; by repeated fractional distillation, he obtained two isomeric substances—α, boiling at 243°, sp. gr. 1·307 at 18°; and β, boiling-point 253°, sp. gr. 1·3259 at 18°.—MM. Engelhardt and Latschinow communicated researches made by them on toluolsulpho potassa and the potassium-salts of xylolsulpho acid.—M. Maikopara communicated his researches on α and β naphthalin-sulpho acids and the chloranhydride, amide, and mercaptan of that series.—M. Mendelejeff read a

lengthy paper on specific heat, and his researches on this subject.—This ends the correspondence.

Researches on the Ethereal Derivatives of the Polyvalent (Mehrwerthigen) Acids and Alcohols.—M. Henry.—This lengthy paper, a continuation of a former on the same subject, contains the following sections:—Aniso-derivatives; anisaldehyde; aniso-nitril, or methyl-paroxybenzoyl-nitril—

$$C_6H_4 \left\langle \begin{matrix} CH_3O \\ CN \end{matrix} \right.$$

nitro-aniso-nitrile—

$$C_6H_3(NO_2) \left\langle \begin{matrix} CH_3O \\ CN \end{matrix} \right.$$

New Series of Double Chlorides belonging to the Platinum Bases.—M. Thomsen.—This paper is too much filled with formulæ to be fit for any useful abstraction.

Synthesis of Hydroxylamine.—MM. Ludwig and Hein.

Strychnine an Antidote against Poisoning with Chloral.—M. Liebreich.

Critical Remarks upon M. Otto's Paper on Mercurodiphenyl.—M. Dreher.

Zeitschrift für Chemie von Beilstein, No. 23, 1869.

This number contains the following original papers:—

Derivatives of Naphthalin.—MM. Faust and Saame.—The authors have prepared and fully investigated the chlorinated substitution products of naphthalin. They describe A, what they call addition products, viz.:—Naphthalintetrachloride, $C_{10}H_8Cl_4$, a solid substance fusing at 182°, and crystallising from its chloroformic solution in large rhombohedric crystals; monochloronaphthalintetrachloride, $C_{10}H_7Cl_5$, also a solid substance crystallising in klinorhombic prisms, and fusing at about 129°; dichloronaphthalintetrachloride, $C_{10}H_6Cl_2,Cl_4$, again a solid substance, crystallising in klinorhombic prisms, and fusing at 172°. All these substances are devoid of smell, difficultly soluble in alcohol, more readily soluble in ether and ligroine; their best solvent is chloroform. B, substitution products:—Monochloronaphthalin, $C_{10}H_7Cl$, a colourless oily fluid, boiling at 250°; monochlorodinitronaphthalin, $C_{10}H_5Cl(NO_2)_2$, a yellow-coloured solid, crystallising in needle-shaped crystals, and fusing at about 104°; α dichloronaphthalin, $C_{10}H_6Cl_2$, a fluid, boiling at about 280°; α tetrachlorotribromodinaphthalin, $C_{20}H_8Cl_4Br_2$, a solid substance, crystallising in white needle-shaped crystals, and fusing at 74°; β dichloronaphthalin, $C_{10}H_6Cl_2$, exhibiting prismatically-shaped crystals, soluble in ether, and fusing at about 282°; β tetrachlorotribromodinaphthalin, $C_{20}H_8Cl_4Br_2$, a solid, fusing at 72°; trichloronaphthalin, $C_{10}H_5Cl_3$; heptachlorodinaphthalin, $C_{20}H_5Cl_7$; heptachlorodinitrodinaphthalin, $C_{20}H_7Cl_7(NO_2)_2$; α tetrachloronaphthalin, $C_{10}H_4Cl_4$; β tetrachloronaphthalin, $C_{10}H_4Cl_4$. All these substances are readily soluble in ether, ligroine, and chloroform, but difficultly so in alcohol; they exhibit the smell of naphthalin. The nitro-products are chiefly yellow-coloured soft substances, difficultly obtainable in pure state.

Some Derivatives of α and β Naphthalin Sulpho-Acids.—M. Maikopar.—The substances submitted to investigation by the author are:—The chloranhydride of the α naphthalin sulpho-acid, α $C_{10}H_7SO_2Cl$, a solid substance, exhibiting foliated crystals; readily soluble in ether, sulphide of carbon, and benzol; fuses at 66°. α amide, α $C_{10}H_7SO_2.NH_2$, also a solid substance, readily soluble in water and alcohol, and fusing at 150°. α mercaptan, α $C_{10}H_7S$, an oily fluid, insoluble in water, but soluble in alcohol and ether; its alcoholic solution yields, with an alcoholic solution of acetate of lead, a yellow-coloured precipitate, a lead compound, $C_{10}H_7PbS$. Chloranhydride of β naphthalin sulpho-acid, β $C_{10}H_7SO_2Cl$, a solid substance, insoluble in water, more difficultly soluble in ether than the α compound, crystallises in foliated crystals, and fuses at 76°. β amide, β $C_{10}H_7SO_2.NH_2$, difficultly soluble in water and ether, and soluble in boiling alcohol. β mercaptan, β $C_{10}H_8S$, insoluble in water, soluble in alcohol and ether, crystalline, and fuses at 136°.

Preparation of Kresotinic Acid from Xylol.—MM. Engelhardt and Latschinoff.—1000 grms. of xylol from coal-tar oil were combined with sulphuric acid; a potassa salt of the sulpho-acid was made, properly purified by re-crystallisation, fused with caustic potassa; the fused mass first treated with water, next with hydrochloric acid, and then treated with ether; the ethereal extract treated with a solution of caustic soda. On evaporating the ether, after decantation, a mixture of xylenols was obtained. The aqueous soda solution yielded, after evaporation and saturation with hydrochloric acid, a substance which on investigation was found to be α kresotinic acid.

Combination of Sulphuric Acid with the Oxides of Nitrogen.—Dr. Winkler.—The author's researches gave the following results:—(1) Hydrated sulphuric acid does not absorb deutoxide of nitrogen. (2) Hydrated sulphuric acid combines readily, and with evolution of much heat, with nitrous acid; this combination is very strong and intimate, is not destroyed by heating, but immediately so by addition of water; the chamber crystals (viz., those sometimes met with in the leaden chambers of sulphuric acid works) consist of this compound. (3) Deutoxide of nitrogen and oxygen do not, when sulphuric acid is simultaneously present, combine to form, as usual, hyponitric acid, but form nitrous acid, even when oxygen is in excess. (4) Hyponitric acid combines, in gaseous, as well as in fluid state, with hydrated sulphuric acid; but this combination, supposing it to deserve that name in a chemical sense, is very loose and unstable; heat destroys this compound, hyponitric acid is given off, either unchanged, or it is converted into nitrous acid, which combines with the sulphuric acid, and free oxygen is given off. The mode of this decomposition depends entirely upon the strength of the sulphuric acid under investigation. (5) Sulphuric and nitric acids only form mechanical mixtures together. (6) Nitrous and sulphurous acids yield, when moisture is present (steam in the chambers), hydrated sulphuric acid and deutoxide of nitrogen, which escapes. (7) Hyponitric acid forms, when in contact with moist sulphurous acid, nitrososulphuric acid, exhibiting solid crystalline structure. These researches have been made with the view of illustrating the action of the Gay-Lussac condensers of sulphuric acid works.

Alleged Presence of Dextrine in the Chesnut.—M. Ludwig.—The author has instituted some experiments in order to test the correctness of M. Albini's statement that the well-known eatable chestnuts (*marrons*) should contain from 22·8 to 23·3 per cent of dextrine. The result of the author's experiments is that this fruit does not contain any dextrine at all, which result agrees with those obtained by several other analysts of this fruit.

New Work on the History of Chemistry.—Dr. A. Ladenburg.—Under the title "Vorträge über die Entwicklungsgeschichte der Chemie inden letzten Hundert Jahren" ("Lectures on the History of the Development of Chemistry during the last Hundred Years"), the author has, according to the editor of this periodical, edited a most excellent complementary volume to Kopp's well-known "Geschichte der Chemie." The work alluded to is in the shape of fourteen lectures on the subject; the arrangement is strictly chronological, and, beginning from Lavoisier, contains a complete, yet concise, record of the history of theoretical chemistry up to the present day. This work is highly eulogised by Dr. Fittig, who wrote a review of it for the above-named periodical.

Les Mondes, December 30, 1869.

Letters on Geology.—M. L'Abbé Choyer.—Although not exactly belonging to the subjects generally treated of in our publication, we call attention to these letters, which are written with great skill, and contain, condensed, a large amount of very useful and interesting information.

Cosmos, January 1, 1870.

Displacement of the Bed of the River Rhine.—M. Boulot.—The course of the Upper Rhine has very greatly altered, its movement being from west to east (a lateral movement to the course of the downward current) between the Alsatian and Baden banks.

Bread and Railway-Sleepers.—By an order recently issued by M. le Maire de Douai, the bakers of that town have been prohibited from using the wood of old railway sleepers as fuel for their ovens, since many of these sleepers have been impregnated with sulphate of copper, and there is danger that some compound of copper might poison the bread. To the Maire, as head of the local police, is entrusted the proper supervision of everything which may injuriously affect the health of the population.

Journal für Praktische Chemie, No. 15. 1869.

This number contains the following original papers:—

Some of the Substances met with in the Leaves and Bark of the Cerasus Avida.—Dr. Rochleder.—In a lengthy memoir, we find the enumeration of a lengthy series of substances partly met with in the leaves, and more especially in the bark, of the tree alluded to. The leaves contain amygdaline, some citric acid, quercitine, and a substance, $C_{21}H_{20}O_9$; the bark contains—phlobaphen, fuscophlobaphen, æsculic acid; rubrophlobaphen, a peculiar taunin, isophloroglucine, and isocaffeic acid.

Cane Sugar in Madder-Root.—M Stein.—The author states that the existence of cane sugar in madder-root has not been hitherto proved. This statement is, however, erroneous, since even about the latter end of the last century attention has been directed to the fact that madder-root, and especially the Zealand madder, is rich in cane sugar, containing between 14 and 16 per cent. The extraction of this sugar, without interfering with the tinctorial value of madder, and by means different from those whereby that sugar is now utilised—viz., fermentation, and making of alcohol—is not elucidated, only discussed, in this paper. Since some 10.000.000 kilos. of madder are, at the very lowest estimate, consumed annually, and since the bulk of the sugar therein contained is utterly lost, there is a fair field of profitable experimental research still left open and untouched.

Fermentation Induced by the Microzyma of the Liver.—M. Kolbe.—320 c.c. of absolute alcohol, 40 grms. of freshly-cut-up sheep's liver, and 16 litres of water, were left standing for five months. The fluid was found to exhibit a very acid reaction, and to give off the odour of sweat. After filtration, the fluid was submitted to distillation, the retort being placed in a chloride of calcium bath, the distillate neutralised with soda, and the alcohol, which had come over unchanged, removed by distillation; the residue, treated with sulphuric acid, yielded capronic and other fatty acids.

No. 16, 1869.

None of the papers of this number are original, and the contents have been abstracted by us already. The death of the chief editor has caused this deviation from the rule; but the publisher states that satisfactory arrangements are being made to obtain original communications.

Zeitschrift für Chemie von Beilstein, No. 1, 1870.

This number contains the following original papers:—

Behaviour of the Flesh-Coloured Sulphide of Manganese with Various Reagents and at Variable Conditions of Temperature and Pressure.—M. Muck.—The sulphide of manganese alluded to was submitted, in sealed tubes at from 140° to 150°, to the action of water, sulphuretted hydrogen, hydrosulphuret of ammonium, polysulphide of potassium, ammonia, and caustic potassa solution. No very perceptible reaction was seen with water, sulphuretted hydrogen, and ammonia; with sulphide of potassium, the bulk of the manganese sulphide was left unaltered, but a small portion of the tube was coated with a very firmly-adhering violet precipitate; hydrosulphuret of ammonium caused complete conversion into green sulphide; with caustic potassa, the sulphide of manganese was converted into greyish white hydrated protoxide of the metal.

Action of Hydrochloric Acid upon Nitrobenzol.—Dr. Baumhauer.—When concentrated hydrochloric acid and nitrobenzol are heated in sealed tubes to 245° (the tubes often explode), there is found in the tube, after cooling, a crystalline substance, which, on being treated with boiling water, yields hydrochlorate of dichloraniline, some hydrochlorate of aniline, an oily substance difficult to purify, and a solid crystalline matter the nature of which could not be further determined; so that, *summa summarum*, this reaction is, in the main features, similar to the action, under the same conditions, of hydriodic and hydrobromic acids, with this difference—that the temperatures for the two last-named are, respectively, 104° and 185°.

Contributions from the Chemical Laboratory at Griefswald.—M. Otto.—A series of papers with the following headings:—On mercuro-diphenyl (a monograph on this subject). Mercuro-ditolyl—

$$\begin{matrix} C_6H_4 < CH_3 \\ C_6H_4 < CH_3 \end{matrix} \quad \begin{matrix} \\ Hg \end{matrix}$$

a solid substance, insoluble in water, difficultly soluble in alcohol, and rather more soluble in hot benzol, chloroform, and sulphide of carbon; it fuses at 235°. Mercuro-monotolyliodide, a solid substance, insoluble in water, difficultly soluble in alcohol, and fusing at 220°. Aceto-mercuro-monotolyl—

$$\begin{matrix} C_6H_4 < CH_3 \\ \\ C_2H_3O-O \end{matrix} \quad \begin{matrix} \\ Hg \\ \\ \end{matrix}$$

a solid, crystallising in rhombic prisms, fusing at 153°, somewhat soluble in boiling water, but better soluble in alcohol and benzol. Behaviour of dibenzyl at a higher temperature (chiefly a series of formulæ). Conversion of this phenol (phenylsulphohydrate) into phenylsulphide. Mercuro-dinaphthyle. Aceto-mercuro-monomethyl and aceto-mercuro-monoethyl. Preparation of organic sulphur compounds by means of hyposulphite of soda.

Non-Volatile Acids, of Croton Oil, and the Non-Existence among them of an Acid $C_4H_6O_2$.—M. Geuther.—A review of the author's labours as compared with those of others on this subject.

Conversion of Isobutyl-Alcohol into Tertiary Pseudobutyl-Alcohol.—Dr. Markownikoff.—The reactions are represented in the following manner:—

$$\underbrace{\begin{matrix} CH_2I \\ CH \\ CH_3CH_3 \end{matrix}}_{\text{Isobutyl-alcohol}} - HI = \underbrace{\begin{matrix} CH_2 \\ \| \\ C \\ CH_3CH_3 \end{matrix}}_{\text{Isobutylen.}}$$

$$\underbrace{\begin{matrix} CH_2 \\ \| \\ C \\ CH_3CH_3 \end{matrix}}_{} + HI = \underbrace{\begin{matrix} CH_3 \\ CI \\ CH_3CH_3 \end{matrix}}_{\text{Tertiary Butyl-iodide.}}$$

Azoxytoluide.—M. Petrieff.—After briefly stating that M. Jaworski calls azoxytoluide an oil-like substance, the author says—The substance prepared by me from azotoluide by the action of sodium-amalgam is a solid crystalline substance, fusing at 57°, and soluble in ether and alcohol. On being treated with sodium-amalgam, it yields hydrazotoluide.

Preparation of Aniline-Red without Arsenic.—M. Coupier.—The author has succeeded in obtaining fuchsine by the action of hydrochloric acid and iron, in small

quantities, upon pure aniline and nitrotoluol, taking care to apply a suitable temperature. Commercial aniline and commercial nitrobenzol also yield the same result; and M. Schützenberger states that, having been requested to test the results of this reaction, he has found that the aniline-red obtained is identical with that ordinarily made, and declared it to be a salt of rosaniline. The yield is very fair, and somewhat larger than when arsenic is used.

Cosmos, January 8, 1870.

Platinum Light.—M. Schinz.—According to the author's experiments, platinum, made incandescent, and brought to bright white heat by means of the ignition of a mixture of hydrogen and carbonic oxide gases, yields a light which, in relation to good coal-gas, is as 1·24 to 1 0.

Origin of the Fatty Oil contained in Olives.—M. Harz.—According to the author's experiments, the results obtained in this investigation are:—The substances secreted in the fruit do not, at its first formation, contain any fatty oil. Up to the time of ripening there exist in the fruit, in the state of membranes, undeveloped cells, which become the seat of secretion of the oil, and which membranes may be rendered visible by means of reagents; each of these rudimentary cells contains a very large number of extremely small cells, which, at the time of ripening of the fruit, are converted into fatty oil. The membrane just alluded to may be rendered visible by the successive application of a solution of aniline and chloroiodide of zinc, whereby the membrane of the cells which contain a fatty oil assume a beautiful blue colour.

Discovery of Coals in Algeria and Turkey.—According to a statement in the *Echo d'Oran*, it appears that there has been found, near Laghouat, an excellent and abundant seam of coal, near the spot where the ancient Romans worked manganese, iron, and zinc mines. As regards the last-named country, M. Hochstetter states that he has found coal near Kézou'ik, under the carboniferous limestone on the southern slope of the Balkan mountains.

Observatory on Mount Ararat.—The Russian Government have resolved to establish an astronomical and meteorological observatory on this mountain, situated near Tiflis, in consequence of the excellent report given by M. Piazzi Smyth of the fitness of such high situations, deduced from his experience on the Pic de Teneriffe.

Discovery of an Ancient Silver Mine.—The recent earthquakes in Germany have caused the fall of a large mass of rocks situated between Heidelberg and Weisloch and in consequence thereof the works of a silver mine, worked by the ancient Romans, have been brought to light. There is no silver-ore of any importance left, but, instead, a very rich zinc ore is met with in large quantity, which was left untouched by the former workers.

Polytechnisches Journal von Dingler, first number for November, 1869.

This number contains the following original papers relating to chemistry or allied sciences:—

Dioptrical Notices.—Dr. Pohl.

Estimation of Sulphur and Gypsum in Animal Charcoal.—M. Reichardt.—The main feature explained in this paper is, that animal charcoal may, and often does, contain considerable quantities of gypsum; but, besides this, sulphur, apparently in combination with carbon, in a similar manner as sulphur may be met with in coke. The estimation of the sulphate of lime is effected, either by boiling the material under investigation with pure hydrochloric acid, or repeatedly with a solution of pure carbonate of soda. The sulphur is estimated by fusion and ignition of the animal charcoal with pure nitrate of potassa, and in each case the sulphuric acid is estimated in the usual way.

On Jute.—Dr. Wiesner.

Second number for November, 1869.

This number contains the following original papers relating to chemistry or allied sciences:—

On the Various Means of Saving Fuel in the Metallurgical and Technical Applications thereof.—M. Schinz.—The author discusses, in this memoir, the subject under the following heads:—Increase of the size of the furnaces; decrease of the conductibility of the same; complete combustion; previous heating of air, as well as of fuel; preparation of combustible gases without nitrogen being among the same; highest possible consumption of fuel in a given time; combustion, under increased pressure, of air.

Newest Shape of M. Wild's Polaristrobometer (Saccharimeter, Diabetometer).—M. Wild.—Description of a very ingeniously-contrived apparatus, illustrated by a series of engravings.

Gas for Heating Purposes.—Dr. Zinrek.—The author states that gas from the brown coal from Furstenwald, five miles from Berlin, will be made on the spot, and collected in Berlin in twelve gas-holders, each of a capacity of 750,000 cubic feet. The gas will be carried, as usual, in underground mains, and mainly applied for heating purposes. 100 parts of the gas (sp. gr., 0·5451) consist of:—Hydrogen, 42·36; oxide of carbon, 40·00; marsh gas, 11·37; nitrogen, 3·17; carbonic acid, 2·01; condensible hydrocarbons, 1·09. 3000 cubic feet of this gas have a heating power of one-third of a ton of best coals, and are equal to 1 ton of best Prussian brown coal. 1000 cubic feet of this gas will cost about 5d. in Berlin; and the equivalent value of the heating power of this gas, as compared with a ton of coals, will be 4s. 6d. The works have been made to supply 9,500,000,000 cubic feet of gas annually, or at the rate of 2⅔ millions of cubic feet daily.

Thymol, a New Disinfectant.—M. Paquet.—The author proposes the use of thymol, so-called thymianic acid, the stearopten of the essential oil from *Ptychotis ajowan*, an umbelliferous plant growing in India. In undiluted state, this substance is a caustic, and used in dentistry for the cauterisation of hollow teeth; its advantage in this aspect being that it has not an unpleasant taste, and, being very aromatic, does not affect the breath as carbolic acid does. Its aqueous solution is a strong antiseptic, and possesses disinfectant properties in a very high degree.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, No. 203, 1869.

This number contains the following original papers and communications relating to chemistry:—

Injurious Effects of Impure Alcohol upon Aniline Colours.—Dr. Tillmanns.—The author has examined several varieties of alcohol, and tested the effects upon aniline colours. The most sensitive among these, for impure alcohol, is aniline purple (phenyl-rosaniline). It appears that empyreumatic substances, aldehyde, the peculiar fusel oils due to the substances used in the manufacture of the alcohol—viz., grain (malted or raw), potatoes, the refuse of beet-root sugar manufacture—affect the aniline colours when dissolved in such alcohols and boiled therewith. The best test for the purity of an alcohol is to dissolve in it 1 per cent of perfectly pure caustic potassa, and to heat the solution; it should only acquire a bright yellow colour. Another test is to dissolve 1 part of the aniline purple alluded to in 50 parts of the alcohol to be tested, and to heat the fluid for some time. If, after half-an-hour's heating, no change is observed, the quality of the alcohol is good; but if the latter is not pure enough, the mixture soon becomes turbid, and assumes a red colour. Aldehyde is often present in alcohol, especially if it has been purified by means of charcoal.

Moniteur Scientifique, No. 313, January 1, 1870.

This number opens with a full and lengthy account of the

proceedings taken by the Ministère Public of the Tribunal Correctionel de Paris *in re* the explosion of the 16th of June last on the Place de la Sorbonne, caused by picrate of potassa. From the scientific, as well as other evidence given about the danger of picrate of potassa (several artillery officers and the Director of the Pyrotechnic School at Toulon having been examined), it appears that the substance alluded to is, as might be expected, far less to be feared than gunpowder, gun-cotton, and salts of fulminic acid. The accused, M. Fontaine, was fully acquitted, in every respect, of the charges made against him of having caused manslaughter by imprudence.

Artificial Porphyry.—MM. Sepulchre and Ohresser.—It appears that the authors have perfectly succeeded in utilising the slag of the iron blast furnaces for the manufacture of paving-stones, which withstand a crushing weight of more than 400 kilos. per square centim., and have answered for the purpose of paving several streets at Brussels and Paris, and stood heavy traffic far better than even the celebrated Quenast stones. The streets paved with this material at Brussels have a heavy gradient.

Lignite from Vescovado, Province of Sienna, Italy.—M. Kopp.—At only eight metres under the surface of the soil, is found a layer of lignite of 3·5 metres thickness. This substance, having been submitted to analysis, yielded, on being dried at 115°, 21·80 per cent of water. On being calcined in a closed crucible, 100 parts gave:—Volatile combustible matter, 26·48; fixed carbon, 42·52; ash, 9·20; water, 21·80. When submitted to dry distillation in a gas retort, acetic acid is among the products, and 51 per cent of coke; the quantity of sulphur amounts to 1·36 per cent. 1 kilo. of lignite is capable, on combustion, of evaporating 6·1 litres of water. Since there is no coal found in any part of Italy, as far, at least, as it has been explored, this material is of considerable value to the industry of that country.

Artificial Alizarine.—MM. Meister and Lucius.—These gentlemen write to the editor of the above-named periodical in reference to what was stated about their invention, and abstracted by us (see Chemical News, vol. xx., p. 299; *Ann. Repr. Feb.* '70, *page* 108), and, denying the truth and correctness of what is there given, now explain that they legally deposited the secret of their mode of manufacture with the Burgomaster of Hoechst (Prussia), and that, consequently, legal proof can be given both as to their peculiar process and as regards priority. They also state that the first samples made were not quite satisfactory, but that now they are in full swing, and have such an increased demand for their produce as to render it impossible for them to serve their customers immediately, they having to wait till their turn comes.

Detection of Fixed Fatty Oils obtained from the Seeds of Cruciferæ.—M. Grehant.—Some fatty oils, especially those obtained from the *Cruciferæ* (colza, rape, cameline, mustard), naturally contain sulphur. This may serve for the detection of these oils by boiling some 25 grms. of the same with an aqueous solution of 2 grms. of caustic potassa in 20 grms. of water. When the mixture is poured on to a previously-moistened filter, the filtrate will blacken paper soaked in acetate of lead or nitrate of silver; and, on addition of some hydrochloric or sulphuric acids, sulphuretted hydrogen is given off, easily recognised by the smell. Linseed, nut, sesame, or ground-nut oils, do not contain sulphur, and do not, consequently, give rise to this phenomenon, if treated in the same manner. The experiment is best performed in a clean bright silver capsule, which, of course, becomes at once brown- or black-coloured, owing to the formation of sulphide of silver in a more or less degree.

Revue Hebdomadaire de Chimie, January 6, 1870.

Manufacture of Soda by the Use of Strontia and Ammonia.—M. Ungerer.—When, to a concentrated solution of sulphate of ammonia, is added an equivalent quantity of chloride of sodium, and the fluid heated to boiling-point, mutual decomposition of these salts takes place, and sulphate of soda and chloride of ammonium is formed; the former salt separates as a crystalline powder, and may be removed by filtration from the solution of the chloride of ammonium. The sulphate of soda, having been dissolved in water, may be decomposed by caustic strontia, thus yielding caustic soda; the chloride of ammonium may be converted into carbonate of ammonia by means of chalk. It is doubtful whether this process, theoretically correct, will be commercially available.

Bleaching of Fixed Fatty Oils.—M. Diéterich.—Into a wooden tub, provided with a properly-constructed tap at the bottom, are poured 30 litres of water, wherein 1 kilo. of permanganate of potassa is dissolved. To this mixture is added 50 litres of the oil to be bleached, and the fluids well stirred up for about two days; at the end of that time, 20 litres of boiling water and 5 kilos. of commercial hydrochloric acid are added; the liquid is again well stirred up; and, after two more days, the acid liquor is run off by means of the tap, and, having been removed, the oil is repeatedly washed with boiling water, until all the acid is removed from it.

Beer-Yeast as a Manure.—M. Bernier.—Beer-yeast contains from 7 to 11 per cent of nitrogen; it is easily decomposed—in common parlance, soon rotten. The author mixes 100 kilos. of it with 30 kilos. of slaked lime and 10 kilos. of gypsum, and thus obtains a pulverulent substance, which may be applied in agriculture instead of guano. It is well-known that, especially in summer, large quantities of this yeast are run off into sewers and altogether wasted.

Les Mondes, January 6, 1870.

This number contains the following original paper:—

Instantaneous Production of Artificial Precious Stones.—M. Zelhweskofski.—Many of our readers have seen that the ordinary newspapers have communicated some more or less sensational accounts concerning the instantaneous artificial preparation of precious stones. It appears that the author has discovered some peculiar silicic and aluminous ethers; but it is not true that these yield, on evaporation, precious stones, and certainly no diamonds, as reported by some newspapers, whose editors do not seem to know what diamonds are. Altogether, the communication (excepting the discovery of the ethers above alluded to) is a *canard*.

January 13, 1870.

Aurora Borealis Seen at Nantes.—L'Abbé Trébeden writes, that on the 3rd inst., at ½ past 6 p. m. (local time) he observed a brilliant aurora borealis which occupied an arc of 70° of the horizon, and extended some 20° in height. The temperature of the air was at that moment 7·1°, and the reading of the barometer 768 m.m. The phenomenon lasted fully an hour, perhaps longer; but it became invisible on account of clouds coming up. The city of Nantes is situated in 47° 13′ N. latitude.

On the Nascent State.—M. St. Claire-Deville.—This paper is the first of a series which the author intends to publish in this periodical on a subject which cannot be well rendered in extract. We intend to return to this subject.

Influence of the Phases of the Moon upon the Height of the Barometer.—M. Coloria.—The result arrived at is that there does not exist any definite relation between the height of the barometer and the synodic revolutions of the moon.

Action of Tobacco and Effects of Smoking upon the System.—Dr. Sée.

Comptes Rendus des Séances de l'Académie des Sciences, January 3, 1870.

This number, a great portion of which is devoted to the records of the proceedings of the elections of President Vice-Presidents, and *Membres du Bureau*, contains the fol-

lowing original papers and memoirs relating to chemistry and allied sciences:—

On the Nascent State.—M. St. Claire-Deville.—This paper is identical with that already briefly alluded to (see Chemical News, vol. xxi., p. 36; *Am. Repr., Mar.* '70, *page* 172).

Action of Magnetism upon Gases.—M. Trève.—This paper contains a first short account of a series of experiments made with perfectly pure gases enclosed in so-called Geissler tubes, and submitted to the action of the induction-spark and an electro-magnet of great force.

Origin of Nitrogen Gas Present in what is supposed to be Perfectly Pure Oxygen.—M. Houzeau.—The author mainly states that atmospheric air adheres with so great tenacity to all parts of the apparatus employed for the production of oxygen and hydrogen, that the author found it necessary to heat to redness even narrow tubes, in order to expel the air, while at the same time a rapid current of pure oxygen passed through the same.

Some Remarks on the Artificial Manufacture of Precious Stones.—M. Gaudin.—The author states, in reference to what has been done on this subject by M. Feil, that he (the author of this paper) made artificial precious stones in crucibles many years ago, but that it is far more difficult to obtain really good results by that method than by the use of the oxyhydrogen blowpipe, and that only by the use of the latter really hard stones, not acted upon by the file, can be made.

Motion of Chlorophyl Globules Under the Influence of Light.—M. Prillieux.—A botanico-physiological paper.

Manufacture of Platinised Looking-Glasses.—M. Jouglet.—Abstracted from another periodical.

Two Products from the White Agaricus.—M. Fleury.—The dried agaricus (a kind of mushroom) yields, on being treated with ether, after evaporation of that fluid, two substances—viz., a resin, $C_{51}H_{42}O_{10}$; and agaricic acid, $C_{16}H_{28}O_5$.

Toxicological Properties of Some Rosolates.—M. Guyot.—The author states that the rosolates of potassa, soda, and baryta do not at all act upon the skin; the soda and potassa salts are not poisonous when they are inwardly taken, or introduced into the animal system; rosolate of baryta is poisonous in strong dose, in consequence of the poisonous properties of the base itself.

January 10th, 1870.

Nitrous Acid.—M. Fremy.—The author considers this acid under the three following headings:—(1) Action of water upon nitrous acid. This decomposition is represented by the following formula:—

$$3NO_3+HO=NO_5,+2NO_2.$$

This reaction is modified, however, by the relative quantities of acid and water, as well as by the temperature. When the acid is in excess, there is only nitric acid and deutoxide of nitrogen formed. When a large quantity of cold water is brought into contact with nitrous acid, the latter dissolves in the water, and no decomposition whatever takes place; this solution is far more staple than one would at first think—even a boiling heat does not destroy it at once. (2) Reducing action of the acid.—In this respect, the aqueous solution just alluded to has some similarity with sulphurous acid, chloride of gold is reduced instantaneously, and permanganate of potassa is decomposed. Nitrous acid decomposes sulphuretted hydrogen precisely in the same manner as sulphurous acid does. The author discusses, at some length, the action of nitrous and sulphurous acids in their respective relations to the manufacture of sulphuric acid; and, from his observations, he comes to the conclusion that an excess of sulphurous acid gas in the leaden chambers, and too high temperature, are the real causes of the useless waste of nitrous compounds in the manufacture of sulphuric acid on the large scale. (3) Decomposition by means of hydrogen.—While experimenting on this subject, the author has discovered a new substance in the following manner:—Nitrate of potassa is calcined in a platinum crucible, and nitrite of potassa formed; this is dissolved in water, and the solution thus obtained submitted to the action of sodium amalgam. The nitrite becomes reduced, and the new substance is obtained, exhibiting the following properties:—It decomposes instantaneously, and at the ordinary temperature, the salts of gold, silver, mercury, and copper, yielding, with the three first-named, the pure metals, and, with the last, the hydrated peroxide. Even when an excess of alkali is present, permanganate of potassa solution is instantaneously decolourised; heated with an excess of alkali, ammonia and protoxide of nitrogen are given off, and the reducing properties are at once lost. The researches on this substance are not finished yet.

Eighth Memoir on the Electro-Capillary Phenomena. Part II. On the Electric Currents of the Muscles, Nerves, and Bones.—M. Becquerel.

Estimation of Weak Electro-Motive Force.—M. Becquerel.

Constitution of the Solar Aureola, and on the Phenomena Exhibited by Rarefied Gases Rendered Incandescent by means of Electric Currents.—Rev. Father Secchi, S.J.—A lengthy paper accompanied by several diagrams.

Manufacture of Tam-Tams and Cymbals.—MM. Riche and Champion.—This paper gives a description of the mode of manufacture of the metallic drums often imported from China under the name of gongs. The alloy made use of by the authors consists of 78 per cent of copper and 22 per cent of tin. The operations chiefly consist in a well-managed beating out and annealing of the disc, which is cast of a thickness of 23 m.m. originally.

Action of Dry Chlorine upon Dried Nitrate of Silver.—MM. Odet and Vignon.—The authors, referring to a former paper published by them on this subject, now state that there are two phases to be distinguished in the reactions which here take place—viz, first, chloride of azotyl is formed, and oxygen set free; and, secondly, the chloride of azotyl reacts upon the excess of nitrate of silver. The following formulæ represent these phases:—

$$\text{1st.}\quad \left.\begin{matrix}NO_4\\Ag\end{matrix}\right\}O_2+\left\{\begin{matrix}Cl\\Cl\end{matrix}\right\}=\left\{\begin{matrix}Cl\\Ag\end{matrix}\right\}+O_2+\left\{\begin{matrix}NO_4\\Cl\end{matrix}\right.$$

$$\text{2nd.}\quad \left.\begin{matrix}NO_4\\Cl\end{matrix}\right\}+\left\{\begin{matrix}NO_4\\Ag\end{matrix}\right\}O_2=\left\{\begin{matrix}Cl\\Ag\end{matrix}\right\}+\left\{\begin{matrix}NO_4\\NO_4\end{matrix}\right\}O_2.$$

Synthesis of Hydrosulphuric Acid.—M. Boillot.—The author states that, having filled gas jars with hydrogen, and having placed some sulphur in the same, the passing of an electric spark through the latter, igniting and volatilising it, produced a perceptible quantity of sulphuretted hydrogen.

Analysis of the Waters Contained in Arable Soils.—M. Schloesing.—This interesting paper is chiefly made up of results placed in a tabulated form, and, hence, not well suited for useful abstraction.

Reply to M. Gaudin's Paper "On the Manufacture of Artificial Precious Stones.—M. Feil.—A question of priority.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 17, 1869.

This number contains the following original papers:—

The Antecedents (Vorstufen) of Urea in the Animal Organism.—MM. Schultzen and Neucki.—This paper, communicated from the chemical laboratory attached to and forming part of the anatomical dissection rooms, contains the record of a series of experiments instituted

[English Edition, Vol. XXI., No. 531, pages 45, 46.]

with dogs in order to elucidate, and, if possible, explain, the mode of the formation of urea and the prodromi of that substance.

Iodide and Bromide of Mercury.—M. Oppenheim.—The iodine compounds of the alcohol radicals do not act upon bichloride and bibromide of mercury in the same manner. In the case of the iodides of the alcohol radicals and the bichloride of mercury, there is formed at once an organic chloride and red iodide of mercury; but when organic iodides are brought into contact with bibromide of mercury in alcoholic solution, no action takes place. When, however, bibromide of mercury is dissolved in aceton, and the experiment repeated with this solution, a yellow crystalline substance is obtained; on investigation, this substance proved to be soluble in ether, to sublime without decomposition, and to have for its formula HgIBr. The authors observe that the formation takes place according to the formula $RI+HgIBr_2=RBr+HgBrI$, and that its composition is a new proof of the correctness of the atomic weight of mercury=200.

Isomorphism of the Compounds of Mercury containing Two Atoms of Chlorine, Bromine, Iodine, and Cyanogen.—M. Groth.—A crystallographical paper illustrated by diagrams.

Critical Remarks upon the Paper Read by M. Thomsen "On the Estimation of the Heat Given Off by the Combustion of Organic Compounds."—M. Baeyer.

Cresylo-Purpuric Acid.—M. von Sommaruga.—The raw material employed by the author for his experiments is trinitro-cresylate of ammonia, an article of commerce known under the name of Victoria yellow. After having purified this salt by recrystallisation, it was dissolved in water, and yielded, on the addition of hydrochloric acid, trinitro-cresylic acid. Instead of treating this acid with cyanide of potassium, the author prefers to use the purified Victoria yellow at once, and obtains, on addition to that substance an aqueous solution of the cyanide just named, the cresyl-purpurate of potassa, $C_7H_6N_5KO_6$. When dry, this substance, on being suddenly heated, detonates. A concentrated solution of this salt yields, on being mixed with a concentrated solution of chloride of ammonium, the ammonia salt of the new acid—viz., $C_7H_6N_5(NH_4)O_6$.

Researches on Sandal-Wood.—M. Weidel.—After referring to some old researches on this subject, the author states that he exhausted 20 lbs. of the sandal-wood shavings, first, with boiling water, to which some caustic potassa had been added. The deep-red coloured liquid was neutralised with hydrochloric acid, whereby a bulky brick-coloured precipitate was thrown down. This substance was collected on filter, washed, and dried, and next treated with ether, the excess of the latter removed by means of distillation, the residue diluted with alcohol, and left to evaporate by itself. The author thus obtained, among several coloured substances, a colourless crystalline body, which is soluble in boiling alcohol. This substance, not hitherto known, has been called by the author "santal;" it is only readily soluble in dilute solutions of caustic alkalies, but these solutions soon become coloured while in contact with air, passing from red, through green, to a dirty brown. The alcoholic solution of santal is neutral to test paper, and is coloured deep red with perchloride of iron. Concentrated sulphuric acid dissolves santal, exhibiting a lemon-yellow coloured solution; formula of the dry substance, $C_8H_6O_3$. The author also found a cinnabar-red coloured crystalline material, which he called "santaline," though it is not quite identical with the santalin of M. Meier; according to M. Weidel's analysis, this santalin is $C_{14}H_{12}O_4$. It is probable that santal is in some manner connected with santalin, but this point is a subject for ulterior investigation.

Double Cyanogen Compounds.—M. Weselsky.—This lengthy memoir is divided into the following sections:—Double cyanides, having the general formula $BaCy_2 R_2Cy_2$; sodiumcobaltocyanide, $Na_6CO_2Cy_{12}.4H_2O$; ammoniumcobaltocyanide, $Am_6CO_2Cy_{12}$; phenylammoniumcobaltocyanide, $(C_6H_5N)_6.CoCy_{12}$. And a series of more and more complicated bodies, as instance of which we quote—phenylammoniumcobaltocyanide, phenylammonium hydrate—

$$(C_6H_5N)_6Co_2Cy_{12}.2(C_6H_5NO).$$

Preparation and Properties of Hydrate of Chloral.—M. Thomsen.

Preparation of Selenic and Selenious Acid.—M. Thomsen.—Selenium is acted upon with concentrated nitric acid, and the solution obtained is evaporated until selenious acid begins to sublime; the residue is dissolved in water. This solution may contain, besides selenious acid, some sulphuric and selenic acid; in order to separate these from each other, baryta water is added. Since selenite of baryta is readily soluble in an excess of selenious acid, the addition of baryta water is continued until a small quantity of the fluid having been filtered does not yield any longer a permanent precipitate on the addition of some more baryta water. The fluid, having been filtered, is evaporated to dryness and submitted to sublimation; the selenious acid thus obtained is quite free from selenic and sulphuric acids. Selenic acid is prepared from this selenious acid by dissolving the latter in water, precipitating this solution with nitrate of silver; the insoluble selenite of silver thus obtained is shaken up with a mixture of water and bromine until the latter is, in slight excess. The solution, having been filtered and concentrated by evaporation, yields selenic acid, quite free from sulphuric or selenious acid.

Simple Method for Recovering Iodine from Iodide of Mercury.—M. Henry.—The iodide of mercury is digested with water to which granulated zinc or iron borings are added. A soluble iodide of zinc or iron is obtained; from which the iodine is separated by means of sulphurous acid.

Parachlorotoluidine.—MM. Henry and Radziszewski.—The substance is a solid, hard, brittle, white-coloured body, fusing at 85°, and boiling, without decomposition, at 243°.

Contribution to the History of Sulphuretted Ureas.—Dr. A. W. Hofmann.—A lengthy and concisely-written memoir, not well suited for abstraction.

Some Ethers of Cresol.—M. Fuchs.—The author describes—Ethylcresol, $C_9H_{12}O$; ethylparaoxybenzoic acid, $C_9H_{10}O_3$; ethylencresol, $C_{16}H_{18}O_2$; acetylcresol, $C_9H_{10}O_2$.

Paratoluidine and Bromotoluol.—M. Wallach.—A critical review of M. Rosenstiehl's labours on this subject.

Revue Hebdomadaire de Chimie, January 13, 1870.

Action of Sulphuretted Hydrogen upon Hydrated Peroxide and Peroxide of Iron at the Ordinary Temperature of the Air.—M. Bresciuo.—The author has investigated this reaction by means of the following experiment:—Chemically-pure hydrated peroxide of iron was placed in a glass tube, and all the air expelled by means of a current of carbonic acid gas, which was made to pass, previously to reaching the tube, through freshly-precipitated carbonate of iron suspended in water, in order to remove from the carbonic acid every trace of atmospheric oxygen. A current of sulphuretted hydrogen (also free from air) was then passed over and through the hydrated peroxide for twenty-four hours, and the excess of the latter gas removed by a current of dry and pure carbonic acid, care being taken to bring the temperature to 50°, in order simultaneously to dry the sulphuret obtained. The product thus obtained oxidises only very slowly in contact with dry air, and contains hardly more than mere traces of free sulphur. The author, therefore, concludes that the reaction takes place according to Berzelius's view, represented as fol-

lows:—$Fe_2O_3 + 3H^2S = Fe_2S_2 + 3HO$. When perfectly pure and dry peroxide of iron is experimented with under the same conditions, no reaction whatever ensues.

Action of the Oxygen of the Air upon Sulphuret of Iron.—M. Wagner.—According to the author, sulphuret of iron does not, when exposed to air, change into sulphate or sub-sulphate, but is converted into sulphur and peroxide of iron. Only traces of sulphuric acid are formed at the ordinary temperature; and only when more heat is applied is this acid more abundantly formed. In order to prove this by experiment, monosulphuret of iron was carefully prepared, and divided into three portions. One of these was kept constantly moist, and at nearly 100°, during three weeks. The second was also kept moist, and left at the ordinary temperature of the air. The third, after having been previously dried, was, for three weeks, left in contact with dry air at the ordinary temperature [the sulphuret was dried by means of a current of illuminating gas, at 100°, since a current of air, dried by means of strong sulphuric acid, oxidises the material]. The results of the analysis of these samples, recorded percentically, gave for— I.) Sulphur, 24·35; sulphuric acid, 7·76; ferrous oxide, 61·72; ferric oxide, 6·17. (II.) Sulphur, 28·32; sulphuric acid, 0·96; ferrous oxide, 61·51; ferric oxide, 9·21. (III.) Sulphur, 27·94; sulphuric acid, 2·39; ferrous oxide, 46·43; ferric oxide, 23·24.

Platinised Looking-Glasses.—M. Jonglet.—The platinising compound is prepared in the following manner:—100 grms. of very thin platinum foil is dissolved in aqua regia, the solution carefully evaporated to dryness, the solid chloride next placed on a triturating marble, and gradually mixed with essential oil of lavender. When 400 grms. of the latter have been incorporated with the chloride, the mixture is placed in a porcelain capsule and left standing for several days, the fluid is decanted from any sediment, and filtered as flux. For the above-named quantity of platinum, the following ingredients are used:—25 grms. of litharge and 25 grms. of borate of lead, mixed and triturated together with about 10 grms. of essence of lavender; this mixture is next mixed with the platinising fluid. After a layer of platinum has been formed upon the glass, it is fixed by burning it in by placing the glass in peculiarly-constructed muffles.

Depositing Copper upon Cast-Iron.—M. Weis-Kopp.—The pieces of cast-iron are first placed in a bath made of 50 parts of hydrochloric acid, at 15° Beaumé (sp. gr., 1·105), and one part of nitric acid; next, in a second bath, composed of 10 parts of nitric acid, 10 parts of chloride of copper, dissolved in 80 parts of the same hydrochloric acid as just alluded to. The objects are rubbed with a woollen rag and a soft brush, next washed with water, and again immersed until the desired thickness of copper is deposited. When it is desired to give the appearance of bronze, the copper surface is rubbed with a mixture of 4 parts of sal ammoniac and 1 each of oxalic and acetic acids dissolved in 30 parts of water.

Cosmos, January 15, 1870.

Universal Galvanic Battery.—M. Delaurier.—The author describes, at great length, and accompanied by a woodcut, a Bunsen cell modified by him. He uses an impure chromic acid, and a mixture of persulphate of iron and sulphuric acid. How the impure chromic acid is prepared is not mentioned. Instead of sulphuric acid, a solution of common salt (1 part in 10 of water) is often applied, and the amalgamation of the zinc is dispensed with; this arrangement appears, according to the statements made, to be satisfactory in many instances. The intensity of the action of the cell when chromic acid, persulphate of iron, and sulphuric acid are used, is very great, and the vapours of hyponitric acid, so deleterious with the Bunsen cells, are, of course, avoided.

Gases in Arable Soil.—M. Hervé-Mangon.—Akin to most porous substances, arable soil has the property of condensing gases. The author finds that the quantity of gases thus condensed varies in bulk (for the same quantity of soil) from 2 to 10 volumes of gas.

Railway from Arequipa to Puno and Cusco (Peru).—The highest point above sea level of this railroad is 4633 metres (15,096 English feet)*—that is to say, more than twice the height above the level of the sea that any existing railroad has reached. At the altitude just named, the air is only half as dense as at the surface of the ocean; in other words, when the average height of the barometer at the last-named surface is taken at 28 inches at the height alluded to, its average reading will be only 14 inches.

Archives Néerlandaises des Sciences Exactes et Naturelles, vol. xiv., 1869.

This periodical is published at irregular intervals of time, in volumes containing from six to twelve sheets 8vo. The editor, Dr. E. H. von Baumhauer, the Secretary of the Holland Society of Sciences at Haarlem, is assisted by a number of eminent scientific men. This volume contains the following original papers and memoirs:

Observations on the Periodical Errors of Micrometer Screws made During the Latest Re-Arrangement of the Astronomical Observatory of Leyden University.—M. F. Kaiser.

Improved Method of Direct Estimation of Iron in the State of Peroxide by means of Hyposulphite of Soda.—M. A. C. Oudemans, jun.—Reserved for full translation, since it bears upon an important subject.

Synthesis of Terephthalic Acid.—M. A. C. Oudemans.—After referring to the labours of M. Carius on the subject of the products of the oxidation of benzol, the author states that he found that, besides formic and phthalic acids, there is also formed terephthalic acid, $C_8H_6O_4$. The quantity obtained of that substance is, however, very small. The preparation, and some of the reactions of this acid, are described at great length.

Specific Gravity of some Saline Solutions.—M. A. C. Oudemans.—This paper contains a series of tabulated results of the specific gravity of aqueous solutions of the following salts:—Crystallised sulphate of magnesia, at 14°, and in quantities of from 1 to 40 per cent of the quantity of water; crystallised nitrate of magnesia, at 14°, and in quantities of from 1 to 49 per cent of the quantity of water; crystallised chloride of magnesium, $Mg''Cl_2 + 6aq$, at 14°, and in quantities of from 1 to 48 per cent of the quantity of water; crystallised nitrate of manganese, at 8°, and in quantities of from 1 to 71 per cent of the quantity of water;

remedy the nuisance. The New York company was equally active, and after considerable investigation decided to give up lime purification altogether, and very judiciously introduced the oxide of iron in its place. Thus the largest companies on the island, which supply all the gas consumed below Thirty-fourth street, promptly responded to the suggestions of the sanitary committee and removed the cause of complaint. As these two companies manufacture four-fifths of all the gas produced on the island, and own all the gasworks situated below Forty-first street, a great improvement was at once noticed.

The Metropolitan Company, however, which supplies gas to that portion of the city between Thirty-fourth and Seventy-ninth streets, paid no heed to complaints of the citizens but continued to condemnous obnoxious

results of experiments made with various kinds of wood, among these several samples brought on purpose, from the Netherlands' West Indies; as well as the results of impregnating European wood with various preservative and other

* The height of Mont Blanc is, according to Tralles, 14,793.

substances. The main result is that, among the latter, creosoting is the only active agent, provided the creosote applied contains a large quantity of carbolic acid and the impregnation be complete.

Absolute Expansion of Mercury according to M. Regnault's Experiment.—M. Bosscha.

Method of Analysis of Milk.—Dr. E. H. von Baumhauer.—A valuable and extensive memoir on this subject, but, owing to the engravings and large number of tabulated forms added, not suited for useful abstraction.

Nature of the Fluids Enclosed in some Minerals.—MM. Vogelsang and Geissler.

Mineral Oils of the Netherlands' East Indian Possessions.—Dr. E. H. von Baumhauer.—A very valuable memoir not only for the knowledge it contains on the subject, but owing to its containing compilations from an immense number of analyses and researches on mineral oils dispersed through a large number of periodicals.

Periodical Evolution of Gas in the Protoplasma of the Living Arcellæ.—M. Hartogh Heys van Zouteveen.

Electrical Irritation of Amibæ and Arcellæ.—M. Hartogh Heys van Zouteveen.

NOTES AND QUERIES.

Detection of Opium in Tobacco.—Can you kindly inform me how best to detect small quantities of opium when present in tobacco? Neither Fresenius, nor any other work on analysis that I know of, gives any process that I have found available. By doing so, you will greatly oblige.—E. MORTON.

Detection of Opium in Tobacco.—(Reply to E. Morton.)—Make an infusion of the cigars in water slightly acidulated with acetic acid. Filter, and add basic acetate of lead till all the colouring matter is nearly precipitated; again filter and digest during a whole day with a little animal charcoal. Collect the charcoal, and boil it in alcohol twice or three times, using altogether about a pint of that solvent. Evaporate this solution to dryness on a water-bath, and treat the extract, first with water rendered freely alkaline by ammonia, then with ether, and lastly with alcohol; this is now evaporated, and the residue tested for morphia as usual. 0·02 grms. of opium may be detected by this process in a single cigar.—JOHN MUTER, Ph.D.

Detection of Opium in Tobacco.—(Reply to E. Morton.)—Although it is hardly likely ever to occur that tobacco should be adulterated with opium, the latter substance might be detected by the reactions of meconic acid. Opium does not burn well at all; neither does the *tandoo* (*i.e.*, its aqueous and inspissated extract) do so, for it is a well-known fact that opium smokers can only keep the small quantity they use alight by means of the aid of a spirit-lamp, or by means of an addition of some easily-burning substance to the extract. Moreover, opium is too expensive a drug to adulterate tobacco with, and those who use opium (as, unfortunately, too many do in this country) employ it in a pure state.

filter, washed, and dried, and next treated with ether, the excess of the latter removed by means of distillation, the residue diluted with alcohol, and left to evaporate by itself. The author thus obtained, among several coloured substances, a colourless crystalline body, which is soluble in boiling alcohol. This substance, not hitherto known, has been called by the author "santal;" it is only readily soluble in dilute solutions of caustic alkalies, but these solutions soon become coloured while in contact with air, passing from red, through green, to a dirty brown. The alcoholic solution of santal is neutral to test paper, and is coloured deep red with perchloride of iron. Concentrated sulphuric acid dissolves santal, exhibiting a lemon-yellow coloured solution; formula of the dry substance, $C_8H_6O_3$. The author als found a cinnabar-red coloured crystalline material, which h called "santaline," though it is not quite identical with th santalin of M. Meier; according to M. Weidel's analysis.

Detection of Fatty Oils from Seeds of Cruciferæ.—With reference to the method for detecting these oils by boiling with caustic potassa in a silver capsule, M. Grehant is probably not aware that his process is no novelty. It was known in England prior to the year 1861, and is described in a work bearing that date.—J. W. SLATER.

Test for Soaps.—In the CHEMICAL NEWS (vol. xx., p. 44; *Am. Repr., Sept.* '69, *page* 167), Professor Schulze proposes to estimate the goodness of soaps by observing the relative quantities required to unharden a standard sample of water—an inversion, in fact, of Clarke's water-test. The proposed method takes for granted (tacitly, at least) that the most caustic soap (*i. e.*, the one containing the largest amount of alkali) is necessarily the best—a totally false assumption. A soap may be bad from presence of sophistications, from imperfect saponification, or from either excess or deficiency of alkali; and it is called good only when, in addition to being genuine and thoroughly "cooked," it contains alkali and fat duly balanced, such balance varying according to the purpose in view. Professor Schulze's test might place an adulterated but caustic soap upon the same level with one genuine but mild, or might even lead us to prefer the former.—J. W. SLATER.

Fermentation of Sugar.—(Answer to John Bowring.)—Alcoholic fermentation, upon which you have fixed your ideas, is not the only fermentation of the sugar-refinery, lactic and acetic fermentations being quite as prevalent. My experience does not enable me to say whether hydric sulphide actually *produces* fermentation of either kind in sugar solutions, but it most unquestionably *favours* fermentation. You surely do not require instructions for the preparation of hydric sulphide. You seem to forget that the sulphide referred to is generated *in* the solution, not introduced after having been generated in a separate apparatus.—W. A.

Estimating Manganese by Bunsen's Method.—The following note has been sent us by Mr. Edward Sherer, as an addition to his paper "On the Estimation of Peroxide of Manganese in Manganese Ores" (CHEMICAL NEWS, vol. xx., p. 304; *Am. Repr., Feb.*, '70, *page* 84). He there stated that in estimating the manganese by the method of Bunsen, the iodine solution gave higher results after standing twenty-four hours than before. He now adds:—These higher results are caused by the liberation of iodine by spontaneous decomposition of hydriodic acid, set free by hydrochloric acid, distilled over during the process, as the following experiment shows:—A few drops of hydrochloric acid were added to a solution of iodide of potassium. The solution remained for some hours colourless, but, after standing twenty-four hours, had become quite yellow, and was found to contain free iodine sufficient to indicate 8 per cent of peroxide of manganese when titrated with hyposulphite.

ANSWERS TO CORRESPONDENTS.

NOTICE.—The American Publishers of THE CHEMICAL NEWS *give notice that, in accordance with a suggestion of* MR. CROOKES, *the Editor and Proprietor of the English Publication, they will be pleased to receive and forward to him in London any scientific publications issued in America, for review—and also any Notes and Queries, Articles, Correspondence, etc., for publication or reply. Their facilities of communication with* MR. CROOKES *render this very desirable to all persons in the United States who wish to confer with him. Address to him, care of*

W. A. TOWNSEND & ADAMS,
434 *Broome Street, New York.*

E. K.—We do not intend to publish the lectures spoken of.

F. H. Button.—You had better advertise.

E. Halliwell.—"Laboratory Teaching," by C. L. Bloxam, published by Churchill, will answer your purpose best.

R. Reynolds.—Received, with thanks.

A. Hedley.—Dr. Lunge, of South Shields, will be able to give you full information about the use of aluminate of soda in soap making.

J. Watkins.—To prepare hydrochlorate of aniline and tartrate of aniline you must saturate aqueous solutions of the respective acids with aniline.

C. P. Bahin and others.—You will see the explanation in the present number.

J. T. Thompson.—A work by Dr. Letheby, "On Food," is just published by Messrs. Longmans.

Prof. J. Laurence Smith (Louisville).—Your letter and enclosure have been received, and shall be attended to. The Photometer invented by the Editor is manufactured by Messrs. Elliott and Co., of Charing Cross, London.

W. L.—You had better advertise for the information you require.

J. W. Slater.—Received with thanks.

Pb.—We are not aware of any method which will practically separate lead and zinc on the large scale, other than those contained in Crookes and Rohrig's "Metallurgy," which you quote. A method of separating small quantities of lead from much zinc, without having recourse to the costly subsidence method used at Vieille Montagne, would be of the highest importance.

Books Received.—"Rinderpest: its Prevention and Cure, and Gypsum as a Sanitary Agent." Edinburgh: William P. Nimmo. London: Simpkin and Co. "On the Ozonometer for the Observation of Ozone with an Aspirator; Instructions for its Use, and the Results obtained," by John Smyth, jun., M.A., F.M.S., &c. (From the Author.) "The Year-Book of Photography and Photo News Almanac for 1870," edited by G. Wharton Simpson, M.A., F.S.A. London: Piper and Carter. "Our Domestic Fire-Places," a New Edition, by Frederick Edwards, jun. London: Longmans, Green, and Co. "The Body and its Health, for Primary Schools," by E. D. Mopother, M.D. Second Edition. Dublin: John Falconer. "Second Annual Report of the Committee of the Manchester National Society for Women's Suffrage." "Notes for Students in Chemistry, Being a Syllabus of Chemistry and Practical Chemistry," by Albert J. Bernays, Ph.D., F.C.S. Fifth Edition. London: John Churchill and Sons. "A Manual of Qualitative Analysis," by Robert Galloway, F.C.S. Fifth Edition. London: John Churchill and Sons.

AMERICAN SUPPLEMENT.

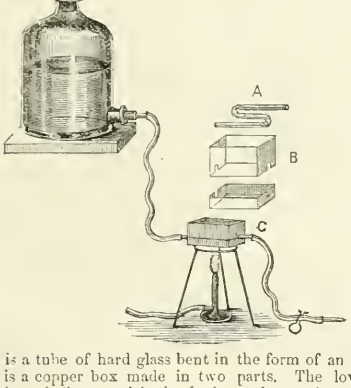
New York, March, 1870.

To Our Readers.

The editor of the *American Supplement* will be very glad to receive articles on chemical subjects, and takes this method of inviting contributions. The editorial work of the London *Chemical News*, which we reprint, is so complete that we cannot supplement it if we would. It gives a full *résumé* of all the chemical news of Great Britain and the Continent, and is by far the fullest chemical journal published. We desire to make the American Supplement as full a record of what is done this side of the water, and request the aid of all who are engaged in this field of investigation.

A Laboratory Convenience.

Mr. H. W. Vaughan, Assistant in the Laboratory of Brown University, at Providence, has devised the new washing arrangement shown in the following figure.



A is a tube of hard glass bent in the form of an *S*.

B is a copper box made in two parts. The lower part is a shallow sand-bath; in its ends openings are cut to accommodate the glass tube A, when it is placed in the sand. The upper part slips directly into the lower part, and is for the purpose of preventing the spilling of the sand.

C represents the sand-bath containing its glass tube in place. The *S* tube is connected by a rubber tube, on the one hand with the supply of distilled water at a higher level, and on the other hand, with a glass jet.

When a precipitate is to be washed with cold water, you have only to loosen the nipper tap on the delivery tube, and direct the stream.

If *hot water* is desired, light a single Bunsen burner under the sand-bath. In one or two minutes after lighting the lamp the hot water is ready, and the heat is abundant to furnish a steady supply of almost boiling water.

By use of this simple arrangement you are saved the annoyance of blowing from the lungs, an annoyance which is especially observed when hot water is to be used. In connection with the filter-pump, where a continuous stream of water is necessary, we have found it especially convenient.

Professor John M. Appleton, of Brown University, speaks very highly of the utility of this apparatus.

The Purification of Coal Gas, and the Gas Nuisance in New York.

Report of Prof. C. F. Chandler to the Metropolitan Board of Health of New York.

(Continued from our last number.)

IV.—HISTORY OF THE GAS NUISANCE.

For years the citizens of New York have complained of a peculiarly offensive smell which was perceived throughout the city to a greater or less degree, according to the weather. This smell was noticed at particular hours of the day, and pervaded large districts, making it impossible to open the windows during its prevalence. By many this smell was attributed to the gases from the sewers, but it was easily demonstrated that the sewers did not, as they do not now, send out offensive gases. The enormous quantities of Croton water used throughout the city make it impossible for the sewers ever to become specially offensive. The smell was peculiar, and was recognized at once by every chemist, and by every one familiar with the manufacture of gas, as the smell of the foul lime which had been used for purifying gas.

The first special complaint against a gas company that I find on record, is that of Dr. E. H. Janes to the Board of Health, against the Manhattan Company, dated April 24, 1866, and printed in the annual report of the Board for that year. The subject was at that time referred to the Sanitary Committee. On the 30th of April following, a committee of the Citizens' Association conferred with the Sanitary Committee on the subject; Professor R. O. Doremus and Professor Samuel St. John appearing as members of the citizens' committee, and the gas companies being represented by some of their officers. As a result of this conference, the Manhattan and New York companies at once turned their attention to the subject and sought means to prevent the nuisance which they admitted to exist. Nor were their efforts in vain. The Manhattan Company made a number of experiments with a view to destroying the foul gases of the refuse lime, and finally introduced the ventilating process which I have already alluded to, and which, with the improvements recently introduced, seems to effectually remedy the nuisance. The New York company was equally active, and after considerable investigation decided to give up lime purification altogether, and very judiciously introduced the oxide of iron in its place. Thus the largest companies on the island, which supply all the gas consumed below Thirty-fourth street, promptly responded to the suggestions of the sanitary committee and removed the cause of complaint. As these two companies manufacture four-fifths of all the gas produced on the island, and own all the gasworks situated below Forty-first street, a great improvement was at once noticed.

The Metropolitan Company, however, which supplies gas to that portion of the city between Thirty-fourth and Seventy-ninth streets, paid no heed to complaints of the citizens, but continued to send out the odors of foul lime. As this company does not manufacture more than one-fifth of the gas supplied to this city, the nuisance was not, however, as general as before. Its works are situated at the foot of West Forty-second street, and the odors are often blown

westward, away from the island. In certain kinds of weather, however, the smell was diffused throughout the city, and complaints were not rare. Some attempts were made to coerce the company, but all responsibility for the smell was stoutly denied by the officers. The members of the Board of Health were on the alert with a determination to compel the offending parties to follow the example of the other companies.

On July 5, 1868, Dr. Stephen Smith, Sanitary Commissioner, and Dr. Elisha Harris, Sanitary Superintendent, noticed the unmistakable smell of foul lime in Thirty-fourth street. They consulted the neighboring vanes, and found that the wind was blowing from the northwest, and walking in this direction, guided by the odor, they came to the Metropolitan Gas Works in West Forty-second street, when they found that a purifier had just been emptied, and the pile of foul lime was still warm and reeking with offensive gases. When these facts were reported to the Board of Health, an order was at once issued, dated July 14, declaring the manufacture of gas at the foot of West Forty-second street to be a nuisance, and ordering the same to be discontinued, except it be conducted by a process that will not allow any deleterious gases or odors detrimental to health to escape into the external air.

Mr. Zollikoffer, the president of the Metropolitan Company, at once requested an opportunity to be heard in defence of the company; and on August 10 he appeared by counsel and showed by his witness that he employed the best coals and purified by the best process, and that the gases evolved by the foul lime were anything but unhealthy—were, indeed, a specific for the whooping-cough and other diseases. The attorney for the Board of Health showed by his witness that the purification as conducted by the Metropolitan Company was necessarily a nuisance, but one that could be easily avoided by following the example of either of the other city companies. The hearing was then adjourned to August 13. On that day the counsel presented a memorial from the gas company, signed by the president. In this they first plead the inexperience of youth, the company being the youngest on the island. They then state that they never heard it even suggested that purification by dry lime was in any way offensive till they received the order of July 14. This is a somewhat remarkable statement, inasmuch as every book on gasmaking admits the nuisance, and since the other companies had, two years previously, in response to the Board of Health, investigated the matter and made the necessary changes, all the particulars having appeared in the daily papers from time to time.

Further, while they protest against the adjudication of the Board of Health that their process of purification is a nuisance, they avow their willingness to try any method which science may suggest and experiment demonstrate to be a better one than that which they are using; and finally requesting that the hearing be postponed till March 1, 1869, that they may experiment on improved methods of purification. The Board finally consented to a postponement of several months.

On February 6, 1869, the hearing was resumed. The gas company had enjoyed a respite nearly six months for this special object, and on a distinct written promise of making experiments; and had not actually made a single experiment during the entire period. One thing only had been done—they sent a man to Europe to learn what processes of purification were in use there. He had returned, but great care was taken when the hearing was resumed not to put him on the witness stand, for his written report was a complete confirmation of all that had been claimed by the witness for the Board of Health with regard to the improved processes of purification there and for preventing nuisance. What did the Metropolitan Company do then, after making written promises and saying so much about good faith, &c.? They made no experiments; did not follow the advice of the man they had sent to Europe; did not do what either of the other New York companies had done to mitigate the nuisance, but at the end of six months appeared by counsel, with distinguished chemical experts, to defend the stench-producing method of purification. For several days the hearing was continued, and nearly 200 printed pages of testimony taken.

I will do justice to Professor Silliman, who was called to testify by the gas company, by stating that while we differed as to the expediency of introducing iron purification instead of lime, he stated clearly and unequivocally on the cross examination that the process of purification as conducted by the Metropolitan Company was necessarily a nuisance, and that by using simple precautions this nuisance could be avoided. This was all that the Board of Health was called upon to prove, and the admission of this by their own witness was evidently understood by the gas company as equivalent to losing their case. So they presented another memorial, or, rather, a set of resolutions, in which they again proposed to experiment. This was on March 4, and the hearing was then postponed till March 22, the company solemnly stipulating to introduce and test the iron or some other improved process.

When March 22 arrived the company again made excuses. "In order to introduce the iron process it was necessary to place false bottoms of perforated plank in the purifiers, and there was only one man in New York who could bore the holes, and he had been busy boring holes for some one else." Still the patience of the Board of Health held out, especially as a prompt enforcement of the order of July 14 might have thrown into darkness all that portion of the city lying between Thirty-fourth and Seventy-ninth streets. Finally the gas company actually began to experiment, but in a very original way. They engaged a man to make a soap with which to wash the smell out of the foul lime. A considerable quantity of it was used, and the members of the Board of Health and several other gentlemen were invited to witness the success of the operation. But the soap did not answer; it was tolerably effective on the upper layer of foul lime, but left the lower five or six layers as offensive as ever.

At last an iron mixture was procured; not one of those, however, which the messenger to Europe had seen in successful operation, and minutely described in his written report; nor yet the one in use by the New York Gas Light Company, but a mixture which was once used somewhere in New Jersey and subsequently abandoned—a mixture of Spanish brown, shell lime, and sawdust. Half the purifiers were filled with this mixture, while the other set were filled with lime as usual. They went through the motions of using this mixture in half the purifiers during most of the past summer, though the gas was actually purified, I think, by the purifiers containing lime. At all events, the mixture did not work, as might have been expected, and this autumn, as soon as the consumption of gas increased, the mixture was thrown out and the purifiers were again filled with lime. So this company has now

gone back to the old process, and in spite of all the evidence to the contrary, and all the time and money expended in bringing out that evidence, it still stubbornly denies the fact that foul lime creates a nuisance, or that any improvements have been made in gas purification.

The offensive process is now in full operation, and, more than that, the foul lime is actually used to fill in a pier. This is specially objectionable, as it has already happened in both London and Dublin, that in making excavations for sewers in places where foul lime had been used for filling in, the workmen were killed by the gases evolved. Five men were killed at one time in this manner in London, in 1849.

Such is the history of the gas nuisance in New York, brought down to date.

V.—WHAT THE METROPOLITAN GAS COMPANY MIGHT DO.

This company has probably spent nearly $10,000 for expert fees, counsel fees, sending to Europe the man whose evidence was suppressed and whose advice was not followed, time of employés, printing 200 pages of evidence, &c., all apparently with the design, not of suppressing the nuisance, but of defeating the honest efforts of the Board of Health in behalf of the citizens of New York. Suppose the officers of this company were really acting in good faith, with a sincere desire to obviate the nuisance, they could at once introduce a better process for purification, a cheaper process, by which they could save $10,000 per annum, or they could retain their present process and ventilate the foul lime. Let them follow the example of either of the neighboring companies, use the iron process of the New York Company, or the ventilating process of the Manhattan Company, or they may select any one of the improved iron processes now used in Europe. All that is asked of them is that they manifest the same willingness to direct their efforts to the management of their business in a manner most conducive to the health and comfort of the city, as was so promptly manifested by the other companies.

VI.—CHANGES REQUIRED.

The introduction of an iron process would require little if any change in the apparatus. Some iron mixtures are employed in exactly the same iron boxes with trays, as the company is now using for lime, while the greatest change that could be necessary would consist simply in taking out the movable trays and introducing a flooring of plank, perforated with auger-holes. A few hours would suffice to make the change; in fact, the plank flooring is already on the ground. A few days would be required to procure the necessary material. As there are two sets of purifiers, either of which could, in case of necessity, be made to purify all the gas made by the company, the change could easily be made without any serious interruption. Until within a short time, the New York Gas Company has been obliged to purify more gas than the Metropolitan Company now makes with purifiers of no greater capacity than one of these two sets. To introduce the ventilating process, considerable additions would be required to the apparatus. A suitable engine, a blower, a washer, and a supplementary purifier for the air used in ventilating would be required, besides a considerable length of mains and the necessary connections. These additions would involve an outlay of several thousand dollars, and some months would be consumed in procuring and erecting them.

VII.—THE AMMONIA WORKS IN EIGHTEENTH STREET.

I cannot consider this report completed until I have referred to the peculiar odor which is evolved in West Eighteenth street, and which is attributed by many to the Manhattan Gas Works. I refer to the odors which escape from the Ammonia Works in that street. The ammoniacal liquor of the Manhattan Works is sold to parties who manufacture from it ammoniacal salts. This liquor contains sulphide, cyanide, and sulphocyanide of ammonium, carbonate of ammonia, and various other compounds which are offensive, but whose exact nature is not known. With careful management the treatment of this liquor need not cause offence, but it is so conducted at these works as to send forth a very disagreeable odor, which is mistaken by persons not familiar with the business for the odor of foul lime. I have noticed this odor, at some distance from the works, almost every time I have visited the neighborhood. The proprietors of the works should be induced to modify their process in such a way as to prevent this nuisance.

SPECIMENS.

In conclusion I beg leave to submit a few specimens of the bog iron ore and oxide of iron mixtures, which I collected in Europe this summer, and which are now in actual use in Liverpool, London, Paris, &c.

Respectfully yours,

C. F. CHANDLER, Ph D.,
Chemist to the Metropolitan Board of Health.

Recent Chemical Patents.

Issued January 4, 1870.

98,466.—Composition for Dyeing and Coloring Leather, Hides, and Skins.—C. Bond, New York.

98,517.—Manufacture of Artificial Stone.—J. M. Ordway, Jamaica Plains, Mass.

98,652.—Apparatus for Tanning Hides and Skins.—W. Y. Warner and J. Crooks, Wilmington, Del.

Issued January 11, 1870.

98,658.—Process of Cleaning Cotton Waste and other Fibres from Oil, etc.—H. M. Baker, Washington, D. C.

98,712.—Mode of Treating Vegetables to Obtain Fibre for Paper, etc.—J. A. Rothe, Philadelphia, Pa.

98,728.—Composition resembling Horn.—W. M. Welling, New York.

98,758.—Process of Preserving Green Corn.—W. L. Gilroy, Philadelphia, Pa.

98,784.—Treating Whiskey and other Spirits.—O. Marland, Boston, Mass.

Issued January 18, 1870.

98,854.—Explosive Compound.—C. Dittmar, Charlottenburg, Prussia.

98,883.—Mode of Producing Light by the Combination of Solid and Liquid Hydrocarbons.—J. Phillips, Cologne, Germany.

98,884.—Material for Tanning, Dyeing, and for other purposes.—F. P. Porcher, Charleston, S.C.

98,896.—Tanning and Stuffing Leather.—W. B. Brittingham, La Fayette, Ind.

99,007.—Alloy of Manganese.—E. Savage, West Meriden, Conn.

Issued January 25, 1870.

99,062.—Manufacture of Artificial Stone.—F. Colgnet, Paris, France.

99,069.—Explosive Agent called "Xyloglodine."—C. Dittmar, Charlottenburg, Prussia.

99,070.—Manufacture of Xyloglodine and other Explosive Agents.—C. Dittmar, Charlottenburg, Prussia.

99,105.—Method of Fixing Pigments to Fibrous and Textile Materials.—A. Paraf, New York.

99,141.—Process of Extracting, Manufacturing, and Refining Sugar.—J. L. Boivin and D. Loiseau, Paris, France.

99,175.—Rectifying Whiskey during Distillation.—H. Fake, Williamsburg, N.Y.

99,180.—Preserving Meat.—H. Gahn, Upsala, Sweden.

99,186.—Drying, Preserving, and Coloring Wood or other Fibrous Material.—H. Haupt, Philadelphia, Pa.

99,192.—Batteries for Electrotyping.—P. S. Hoe, New York.

99,248.—Manufacture of Parchment-Paper.—A. J. Sheldon, Buffalo, N.Y.

99,250.—Process of rendering Lard, Tallow, and other Fats.—A. Smith, Baltimore, Md.

99,251.—Process of Treating Fish to Obtain Oils and Fertilizers.—A. Smith, Baltimore, Md.

99,253.—Process of rendering Ranchi Animal Fats, and for Disinfecting the Gases Evolved.—A. Smith, Baltimore, Md.

Issued February 1, 1870.

99,367.—Manufacture of Iron.—D. Stewart, Kittanning, Pittsburgh, Pa.

99,368.—Manufacture of Iron.—D. Stewart, Kittanning, Pittsburgh, Pa.

99,387.—Compound for Eating and Raising Hides.—G. W. Adler, Philadelphia, Pa.

99,468.—Manufacture of Soap.—H. A. Pease, Hartford, Conn.

99,496.—Dye for Coloring Wool.—G. W. Talbot, Providence, R.I.

99,500.—Manufacture of Oils from Petroleum.—C. Toppan, Wakefield, Mass.

Reissues.

87,487.—Purging and Draining Sugar.—W. H. Guild, Brooklyn, N.Y.

3,804.—Brewing Ale, Beer, &c.—J. McCormick, Boston, Mass.

3,808.—Process of Treating Silver Ores.—C. Stetefeldt, Austin, Nevada.

3,813.—Varnish.—D. R. Averill, New Centreville, N.Y.

3,814.—Manufacture of Varnish.—D. R. Averill, New Centreville, N.Y.

3,816.—Treatment of Leather.—N. C. Russell, Gloversville, N.Y.

NEW PUBLICATIONS.

Die Darstellung krystallisirter Kieselsäure auf trockenem Wege. By Prof. Gustav Rose. A paper read before the Berlin Academie, June 3, 1869. 14 pp.

Prof. Rose describes the various methods by which crystallized silicic acid has been prepared in the wet way. Senarmont (Ann. Chim. Phys. 1851, 32, 142) obtained it in the form of quartz crystals by subjecting a hydrochloric acid solution to a temperature of 200°—300° C. Daubrée (Compt. rend. 1857, 45, 792) obtained it in the form of quartz crystals by decomposing the chloride or fluoride of silicon by steam in an ignited porcelain tube, and also by decomposing glass by water at a high temperature, under pressure. He also alludes to his experiments on the silica which separates in the head of phosphorus salt before the blowpipe. He then proceeds to describe a very interesting series of experiments in which he succeeded in obtaining crystals of tridymite, the variety of silica discovered by von Rath, which has a peculiar crystalline form and specific gravity. He obtained the tridymite by fusing in a porcelain furnace, (1) adular with phosphorus salt, (2) amorphous silica with phosphorus salt, (3) amorphous silica with carbonate of soda, (4) amorphous silica with wollastonite, (5) amorphous silica with borax, (6) finally, by igniting quartz or amorphous silica. Tridymite occurs in volcanic rocks, also in minerals formed in the wet way, as opal. It is characterized by its occurrence in hexagonal plates, compounded in groups of threes; by a peculiar specific gravity of 2·2 to 2·3; and by its slight solubility in carbonate of soda solution and in hydrate of potassa.

A Treatise on Ore Deposits. By Bernhard von Cotta. Translated from the second German edition by Frederick Prime, Jr., Instructor in Assaying, School of Mines, Columbia College. 8vo, 574 pp. D. Van Nostrand, 23 Murray Street, New York.

Proceedings of the American Pharmaceutical Association at the Seventeenth Annual Meeting, held in Chicago, Ill., September, 1869. 8vo, 468 pp. Philadelphia, 1870.

The Chemical Forces: Heat, Light, Electricity. An Introduction to Chemical Physics, designed for the Use of Academies, Colleges, and Medical Schools. By Thomas Ruggles Pynchon, A.M., Professor of Chemistry and the Natural Sciences, Trinity College, Hartford, Conn. 8vo, 534 pp. O. D. Case & Co., Hartford, 1870.

Annual Report of the State Geologist of New Jersey for 1869. By Prof. George H. Cook. 8vo, 57 pp., numerous maps and sections. Trenton, N.J., 1870.

Address to the American Association for the Advancement of Science. By Benjamin Apthorp Gould, August 20th, 1869. 8vo, 39 pp. Salem: Essex Institute Press, 1869.

Notes on Certain Slates, Felsites, and Elvanites occurring near Knockmahon, in the County of Waterford. By J. Arthur Phillips. 8vo, 6 pp. Extract from the *Phil. Mag.*, Jan., 1870.

Trichina Spiralis. A paper presented to the N.Y. State Medical Society at the Annual Meeting for 1869, by E. R. Hun, M.D. 8vo, 16 pp., and plates. Albany, 1869.

Table Talk. A monthly journal, edited by Charles J. Everett. 4to, 8 pp. 201 Fulton Street, N.Y.

The Technologist. A new monthly journal devoted to Industrial Science. Editors: John Phin and L. F. Olney. Managers: J. H. Caswell, L. H. Mitchell, and Dr. Kempson. Published by the Industrial Publication Co., 176 Broadway, New York.

BREVITIES.

The Lyceum of Natural History.—At the meeting of the chemical section, held Jan. 10th, a paper was read by Mr. O. Loew "*On the Production of Ozone by Flame.*" A discussion on the chemical history of mineral carbon and carbon compounds followed the reading of the paper. At the meeting of Feb. 14th, papers were read by—

Prof. A. M. Edwards, "*On Suggestions for Systematizing Chemical Nomenclature.*"

Dr. A. H. Gallatin, "*On Ammonium.*"

Dr. H. C. Bolton (by title), "*Index to the Literature of Uranium Compounds.*"

Prof. C. A. Seely, "*On Dissociation.*"

Frequency of Poisoning.—Prof. Von Uslar, of Göttingen, recently informed the editor, that during the past fifteen years he had been called upon to make three hundred and four examinations for poison. In eighty-seven cases the bodies were found to contain poison. Four or five of these were proved to be suicides. In three cases the suspected parties defeated justice by killing themselves; and in only two or three cases were the guilty persons executed. The poisons found were arsenic, phosphorus, cyanide of potassium, prussic acid, copper, etc.

The Philadelphia Gas Works.—These works are the property of the city, and are managed by trustees. There are 533 miles of mains, 8,127 street-lamps, and the total number of lights is 801,877. During the year 1869, there were consumed 136,502 tons of coal, and 233,296 bushels of lime, which yielded 1,163,162,000 cubic feet of gas and 4,152,276 bushels of coke.

The American Academy of Arts and Sciences, at Boston, has presented gold and silver medals, together of the intrinsic value of $300, the gift of Count Rumford, for the most important discoveries in this country of useful improvements in the application of heat and light, to Geo. H. Corliss, of Providence, R.I., for his improvement in the steam-engine.

The Manufacture of Salt in Michigan and New York.—The Saginaw region is still the only one entitled to be called the salt district of Michigan.

The first salt operations there were commenced in 1859, a company, called the East Saginaw Manufacturing Company, having been organized, and the first well completed in March 1860. The first salt was made in July, 1860. The following summary shows the amount of salt manufactured each year since the business began:—

	Bbls.		Bbls.
1860	4,000	1865	477,200
1861	125,000	1866	497,997
1862	243,000	1867	474,721
1863	466,000	1868	555,690
1864	529,073	1869	577,569

The following table, prepared on November 1, 1869, contains the statistics of the salt business for the year:—

Number of companies in operation	59
Number of blocks	119
Number of kettles	4,178
Number of solar covers	4,304
Number of grainers	128
Number of acres of land covered	9,500
Amount of money invested	$2,432,500
Salt made in 1869, barrels	577,569
Men employed	781
Value of barrels used	$225,026

The following analyses, made by Dr. C. A. Goessmann, Professor of Chemistry at the State Agricultural College of Massachusetts, show the general character of the brines:—

	I. Portsmouth Well.	II. East Saginaw Co.'s Well.	III. Bangor Co.'s Well.
Chloride of sodium	12·53	16·86	19·86
Chloride of magnesium	0·35	0·96	1·26
Chloride of calcium	0·42	2·27	2·96
Sulphate of lime	0·49	0·15	0·07
Total saline matter	13·79	20·24	24·15
Water	86·21	79·76	75·85
	100·00	100·00	100·00
Depth of the well	664 ft.	806 ft.	774 ft.
Temperature of brine	58° F.	62° F.	60° F.
Degree of salometer	54°	80°	95°

It is interesting to notice the relation which exists between the percentage of sulphate of lime and that of the chlorides of magnesium and calcium: as the latter increases the former decreases.

Dr. Goessmann has called attention to the same fact in the mother liquors of the brines at Syracuse, N. Y.

The greater concentration of the Michigan brines is fully offset by their richness in the chlorides of calcium and magnesium. The Syracuse brines are not as strong, but are purer. Dr. Goessmann gives the following analyses:—

	Syracuse.	Salina.
Chloride of sodium	15·36	14·94
Chloride of magnesium	0·14	0·13
Chloride of calcium	0·08	0·08
Sulphate of lime	0·57	0·59
Saline matter	16·15	15·74
Water	83·85	84·26
	100·00	100·00

The quantity of salt manufactured on the salt reservation of New York, in the towns of Syracuse, Geddes, Salina, and Liverpool is now about nine million bushels, of 56 lbs., per annum, consisting of "*Solar*," "*Boiled*," and "*Factory-Filled*" salt. The latter is manufactured by a process introduced by Dr. Goessmann, and is the purest salt in our market. It is prepared by grinding the solar or boiled salt, and washing it with a saturated solution of salt, to which a quantity of carbonate of soda has been added, sufficient to decompose the chloride of calcium contained in the salt. It is then drained and dried.

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NOTES FROM THE LABORATORY OF A SUGAR REFINERY.

BY WILLIAM ARNOT, F.C.S.

(Continued from Am. Repr., March, 1870, page 129.)

VIII. Char "Diseases."

The "diseases" to which animal charcoal is subjected are very varied in their nature, and proceed from widely different causes. Upon this subject some very erroneous ideas are entertained by many of our refiners, as well as by scientific men. The manner in which certain specifics have been recommended and employed, with a view to cure almost every variety of "disease," testifies to the truth of the assertion. It is the writer's intention in this note briefly to notice the several diseases which have come under his own observation, and with the cause and cure of which he has had more or less to do.

1. *Deficiency of Carbon.*—This is a very serious defect, and one much more prevalent than might be supposed, considering that, in certain classes of refineries, the carbon increases, rather than diminishes, by continued use. A good working char should contain from 9 to 11 per cent. of carbon; when it falls below 9, some agency is at work which ought at once to be enquired into. Faulty slides or joints will be admitting air to the ignited char in the kilns or coolers; or the system may be such that the char has to pass through the air on its way from the kilns to the coolers; in either case, a portion of the carbon is oxidised, and the proportion consequently reduced. Or the re-burning may be conducted at too high a temperature, a reaction taking place, in consequence, between the carbon and water—the latter being decomposed, and compounds of the former formed; or, further, deficiency of carbon may arise from the use of sugars containing large proportions of sulphates and sulphites, as indicated in Note III. The cause discovered, the cure is simple—have the kilns repaired, or renewed; re-burn at a more moderate temperature; avoid the use of sugars impregnated with sulphates and sulphites. Of course, attention to these points cannot restore the carbon already gone, but will prevent a further reduction of this valuable agent; the carbon may, indeed, increase, but it is questionable whether the increase will improve the quality of the char. The want of carbon is one of the worst diseases incident to animal charcoal—the reduction of that agent from 9 or 10 per cent to 6 or 7 means a reduction in decolourative power very much greater than these figures indicate; the preservation of the carbon ought, therefore, to be a special study of the refiner. The writer has before him at the present moment a sample of char from a working stock of several hundred tons, containing under 5 per cent of carbon; how a refinery with such a char stock can yield a profit to the refiner is more than he can guess.

2. *Excess of Carbon.*—As already indicated, the carbon usually increases by continued use; in some refineries, this increase is rapid and great, so great, indeed, as to amount to a "disease." This disease may arise from defective washing, or from the use of water containing considerable quantities of vegetable matter. The deposit of carbon, by the decomposition of organic matter in the process of re-burning, clogs up the pores of the char, just as any other impurity does; its injurious action ends there, however, having no active deleterious action in itself, as some other impurities have.

3. *Oxide of Iron.*—The presence of this agent in any considerable quantity may well be considered a "disease": it is most injurious and potent in its action. The faintest trace of iron in the refined product at once manifests itself on the addition of tannic acid or tea; and so injurious to the commercial value of the sugar is the presence of even the minutest quantity of that agent, that its avoidance is worth any expenditure of care and cash on the part of the refiner. Iron may accumulate in char from various causes—in the process of re-burning there is, no doubt, a slight and unavoidable increase, but, with care, this need not be serious; if, however, defective kilns and careless manipulators are employed, this may prove a very fruitful source of iron. Here, therefore, is another inducement to the refiner to attend to the careful maintenance of his re-burning apparatus. But a more general source of iron is to be found in the action of sour or acid "washings," "scum-waters," &c., upon unpainted or defectively painted cisterns, moulds, &c. These "washings" impregnated with iron are used in dissolving raw sugars, or are concentrated and run through fresh char; a portion of the iron is extracted by the char and is ready to be given up to the first acid liquor that follows. There is thus a constant addition and abstraction of iron, which becomes about equal when about 0·7 per cent of oxide has been incorporated with the char. A thorough system of painting, with the avoidance of acid liquors, waters, &c., as far as practicable, is recommended. A portion of the iron may be removed from char suffering from this disease by the use of dilute hydric chloride and some other agents; but, as this subject will be treated of in a separate note, it need not be the subject of further remark here.

4. *Lime.*—Accumulations of this agent in the pores of the char reduces the poteney of the char as a decolouriser, and may otherwise injuriously affect the sugar liquors passing through it. This is not a disease very common in this country—at least, not to any serious extent. Several refiners, fancying their char was loaded with this agent, have expended large sums upon curative processes, but generally to no purpose, as the lime was more usually found to be deficient than excessive. Beanes's most admirable process for the removal of lime from char has, to a certain extent, failed in this country, —not from any defect in the process, but from a want of the material to operate upon. A more ingenious and trustworthy process *for the removal of excess of lime* could not well be devised; and, on the Continent, where lime rapidly accumulates in the char in the process of refining "beet," the patent process would yield most excellent results. The writer has, on more than one occasion, had cause to feel surprise at statements made about Mr. Beanes's system, especially by chemists. It was defective because you could not wash the char free from acid; could not regulate the supply of gas to the requirements of the char; and other statements have been made, which simply show that the process was never understood by the parties making them. The process is free from all such objections, and, where lime exists in such excessive proportion as to render its removal desirable, no fear need be entertained with regard to the application.

5. *Overburned Char.*—Char that has been repeatedly overburned contracts—shrivels up, so to speak; the

[English Edition, Vol. XXI. No. 532, page 49.]

pores become smaller, or cease to exist. This is a serious defect, and one which cannot be remedied.

6. *Glazed Char.*—The glazing of char has been attributed to several causes by different writers; but the author, although he has given some attention to the subject, is by no means satisfied as to the real cause or causes. Friction may have something to do with it; but this is not the initial cause: defective washing will be more likely to account for it. That glazing is injurious to the char is beyond question; when chars become very highly glazed, their decolourative power is more or less reduced.

7. It is only necessary to indicate that two or more of the above diseases may obtain at the same time, and that complication of diseases renders successful treatment very difficult of attainment.

IX. Char Treatment.

When a refiner discovers his char stock to be in a "diseased" condition, he naturally begins to look about for some method of treatment, by the adoption of which the quality of his char may be improved. The search is usually made in a hap-hazard way; no very definite notion of what the disease really is which affects his char having been obtained, a process for the removal of iron or lime may be adopted when the real source of the inefficiency of the char may be excess or deficiency of carbon, or such like. The first step which ought to be taken when a char ceases to give satisfactory results is to have it carefully analyzed; but this will be of comparatively little use if analyses have not been formerly made. A regular monthly or bi-monthly analysis of every refining stock should be made, and the results of each compared with those preceding; the refiner will thus be able to trace the nature and progress of disease in his char, if any exists. If suspicion is thus aroused that all is not right, more frequent analyses should be made, and, at the same time, some well-considered system of treatment adopted. It may be well to draw attention here to the obvious necessity for such analyses being made with rigorous care. An increase or decrease of carbon from week to week or from month to month of 0·5 per cent, increase or reduction of calcic carbonate to the same extent, or an increase of iron to the extent of 0·1 per cent of oxide, are most important indications, and ought to receive the special attention of both analyst and refiner.

A fair idea of the nature of the defect having been obtained, the mode of treatment most likely to improve the char must be carefully considered. It will very frequently be found that the safest, most efficient, and, in the end, least expensive course to follow will be to increase the washing; to use the washing water boiling, instead of simply "warm"; to see to the kilns and coolers being tight, and the working of them specially attended to; to reject suspicious sugars; and generally to give greater attention to the employment of careful and efficient workmen. The writer has more faith in measures such as these, than in the hasty adoption of special systems of treatment, which often lead to mischievous results. But, in the face of every precaution, "diseases" do creep in sometimes, and the adoption of some special measures may be imperative; but, whatever the system to be adopted, numerous and frequent, carefully-conducted, small-scale experiments should first be made. The diseases open to special treatment are, as indicated in the preceding note, principally excess of lime and iron. For the removal of these, the following processes have been adopted with more or less success.

1. *Fermentation* of various kinds and degrees. The char may be left in the cisterns with a little "sweet" remaining in it (*i.e.*, without being thoroughly washed) for some days, during which time a brisk action will take place: the traces of sugar, as well as the several organic impurities left in the char, are decomposed, with formations of various weak acids, which combine with the lime, forming salts easily removable by washing. Or a quantity of "sour water" may be run upon the char, and allowed to stand as before; the action will be the same, slightly intensified. Many modifications of this system are in use, the action in all cases being the same in kind, differing only in degree. Crude acetic acid and churned milk have also been used to promote and intensify acetic and lactic fermentations.

Fermentation is a simple and cheap mode of treatment, but the results, although generally in the right direction, are not usually very great. The amount of acid produced is comparatively trifling, and has seldom any action upon the iron, enough lime being generally present to saturate the acid as produced. It has its harmlessness to recommend it; but it keeps the char an objectionably long time out of use, and, moreover, monopolises the char cisterns to a serious extent. This latter objection may be got over by adopting a system of "dry fermentation," in which the char, well drained, but moist, and containing the fermenting agents already referred to, is removed from the cisterns, and allowed to lie in a heap for a week or two, or until all action has ceased. This process, however, involves a large amount of additional labor, and, as in the other case, keeps the char out of use longer than desirable.

2. *Dilute Hydric Chloride* has been used, in various ways and in all degrees of strength; and, for the removal of iron, perhaps no better agent can be employed. Sodic sulphite has been recommended to be used, along with hydric chloride, for the removal of iron; but the writer has not found the results of such treatment at all satisfactory. Hydric chloride must at all times be used with extreme caution; very dilute solutions should always be preferred, though the amount of lime or iron removed should be the smaller. The effects of any acid treatment is never perfectly satisfactory: the amount of impurity removed is generally less than anticipated; danger of injuring the structure of the char always exists; in whatever way the acid is applied, some of the char is certain to get more than its share, another portion getting less; while the entire removal of the acid from the char, after it has done its work, is difficult, if not impossible. Char, after having been treated with acid, washed, and re-burned, always shows an acid reaction—so difficult is the acid to wash out; and this residual acid has the effect of misleading the refiner when his sugar-liquor passes through the char for the first time. The liquor will look unusually bright, and light in colour; but colour due to the presence of traces of acid is valueless, as, in the process of boiling, it entirely disappears. Dr. Wallace, in his lecture to the Chemical Society, indicates that the colour of the sugar produced in such circumstances is superior, though the syrups are increased in quantity. This the author has not found to be the case; the syrups are increased, but the colour of the sugar is not improved.

3. *Gaseous Hydric Chloride.*—Mr. Beane's process has already been referred to (Note VIII.). When the circumstances which obtain are such as to warrant its use, great care must be taken to have apparatus of the

best construction, and thoroughly trained workmen to attend to the various operations involved. When the excess of lime has been removed, the process will, of course, be stopped until, by a sufficient increase of that impurity, it can again be used with safety and with profit. Dry gaseous hydric chloride has no action upon the iron; so that, for the removal of that powerfully-injurious agent, it is inapplicable.

Various other acids have been used with a view to improve the quality of animal charcoal, but (unless in very special cases) with very discouraging results. Even carbonic acid has been used, forced into the char in the gaseous form under high pressure, under the impression that the calcic carbonate would be changed into bicarbonate, and thus rendered soluble. This may serve as an illustration of a rather numerous class of "inventions," the results of which are not only valueless, but, in some cases, most injurious. A case has come under the writer's notice, almost too absurd to be mentioned, in which undilute oil of vitriol was poured direct from the carboys upon the char in the cisterns. After the mixture had been allowed to act *a sufficient length of time*, it was dug out in blocks with picks! This process was conducted under chemical supervision!

The preservation of char in a state of efficiency is perhaps the most important problem in the sugar-refining industry; and certainly it were much better for the refiner to devote his best energies to the retention of his char in good condition, than to be compelled to adopt expensive, troublesome, and often questionable processes, with a view to restore qualities which, through careless working, have been lost. The question of char treatment is a most troublesome one; and, although almost every likely process has been practically tried, both on the large and small scale, by the author, the results have never given him unalloyed satisfaction. He is, therefore, the more desirous of impressing upon refiners the desirability of caring well for good char when they have got it.

A favourite "cure" for faulty char with some, is to mix in new or faultless char in various proportions; but, as must be self-evident to any one who will carefully look at the subject, this is only to disguise the weakness of the old by the potency of the new. A char having a higher average quality will doubtless be the result of such a mixture; but it is a mistake to suppose that the faulty char will thus be cured.

St. Anne's Laboratory, Lasswade, N.B.,
January, 1870.

ON THE TECHNICAL ANALYSIS OF SOAP.*

BY M. GASTON TISSANDIER.

The name of soap is given to true salts formed by combining fatty acids (oleic, margaric) with alkalies, such as soda or potash. The quality of a soap is ascertained by determining the proportion of fatty acid and alkali which it contains, and also the foreign substances—such as chlorides, alkaline sulphates, moisture, &c.—which always occur in varying proportions.

Fatty Acids.—Dissolve 5 grms. of the soap in question in ½ a litre of distilled water heated in a porcelain capsule; when dissolved, add a slight excess of dilute sulphuric acid, and let it boil for some minutes, so that the fatty acids may become separated and float upon the liquid. To weigh the fatty acids, cool them, and they will form a cake of grease, which must then be fused, in order to dry them, in a small tared porcelain capsule; this capsule, when again weighed, will give the amount of fatty acids corresponding to 5 grms. of soap.

Wax may also be used to facilitate the weighing. After the first part of the operation has been performed, and the fatty acids are floating, add 7 grms. of white wax, which will melt and mingle with them; cool the whole, take out the cake of wax, and weigh it, previously drying it between double filtering papers. The excess of weight gives the proportion of fatty acids.

Ash.—Soda.—Calcine, at red heat, 5 grms. of soap in a platinum capsule. Weigh the ash thus obtained, and dissolve it in 200 c.c. of distilled water; determine the proportion of soda in 100 c.c. by means of normal sulphuric acid (alkalimetric standard), evaporate to dryness, and notice the action of bichloride of platinum upon the residue dissolved in water, to ascertain whether it consists of potash or soda. The estimation of the soda may be verified by directly taking the alkalimetric standard of the soap (5 grs.).

Chloride of Sodium.—Estimate the chlorine in 50 c.c. of the solution with the standard silver solution.

Sulphate of Soda.—The sulphuric acid is estimated in the remaining 50 c.c. of the solution with chloride of barium.

Non-Saponified Fatty Bodies.—These also occur in soap, and may be detected as follows:—Dry 5 grms. of soap at 110°, after which treat it with common ether. Agitate it with that liquid in a flask, filter it, wash with ether, and evaporate the solution at 100°; the residue will be the non-saponified fatty bodies. The ether may, perhaps, dissolve a little of the soap; it must, therefore, be ascertained that the residue is really fat—melt it, and try whether it will soil glazed paper.

Non-Saponified Carbonate of Soda.—Cut 5 grms. of soap into small fragments, and treat them with boiling alcohol, which does not dissolve carbonate of soda. Filter, and treat the insoluble residue with alcoholic acetic acid, which dissolves the carbonate of soda without acting on the sulphate of soda and chloride of sodium. The acetic solution, evaporated to dryness and calcined, leaves, as a residue, carbonate of soda. Weigh it, and, if verification be required, take its alkalimetric standard.

Glycerine.—Dissolve 5 grms. of soap in boiling water, decompose it with dilute sulphuric acid, and separate the isolated fatty acids by decantation. The liquid, which is completely neutralised by the carbonate of soda, is now evaporated to dryness over a water-bath at 100° C.; the residue, composed of sulphate of soda and glycerine, is taken up by alcohol, which dissolves only the latter; it is then filtered and evaporated to dryness, when the residue will be glycerine. This is again taken up by alcohol, re-evaporated, and the residue again weighed, after ascertaining that it possesses all the properties of glycerine.

Water.—Cut the soap into thin slices; weigh 5 grms., and dry them on a stove at 120° C.

Composition of Various Kinds of Soap.

Substances estimated.	I.	II.	III.	IV.
Water	46·12	24·76	17·55	14·09
Soda	4·98	7·30	8·48	9·01
Fatty acids	37·99	64·50	71·45	74·68
Chloride of sodium	6·30	3·12	2·12	2·00
Sulphate of soda	0·72	0·32	0·40	0·22
Fatty bodies	1·00	—	—	—
Glycerine	2·89	—	—	—
Total	100·00	100·00	100·00	100·00

* *Moniteur Scientifique.*

[English Edition, Vol. XXI., No. 533, pages 61, 62; No. 533, page 50.]

ON MICROSCOPICAL MANIPULATION.*

BY W. T. SUFFOLK, F.R.M.S.

(Continued from Amer. Repr., March, 1870, page 140).

The subject of drawing materials is of some little importance, and, as it is not treated upon in any microscopical work, a few remarks may not be out of place.

Probably no material is capable of representing elaborate microscopical subjects with so much truth as *water-colour*. When used with all the appliances of the modern school of painting, both colour and texture can be very closely imitated by skilful artists; but few have turned their attention to this subject; and, as the process is costly and not easy to acquire without a considerable amount of study, the use of this mode of representation will, in all probability, be very limited. Those who possess the requisite skill are strongly recommended to make use of it. Even as pictures, groups of aquatic animals and plants are quite as beautiful, both in form and colour, as flower compositions; and no other means of delineation, excepting the still more difficult art of oil-painting, can approach the truth of a highly-finished water-colour drawing. Unfortunately, at present, no means exist of re-producing these beautiful pictures, as their extreme delicacy places them beyond the powers of chromo-lithography.

The effect of outline sketches is much improved by the judicious employment of tints of water-colour; and this is by no means a difficult process, as it is a mere matter of laying on colour; while, in painting proper, quite as much is done by taking off paint as by putting it on, and also every advantage taken of the texture of both paper and pigment.

Pencil drawing is particularly useful for microscopical purposes. Fine lines can readily be made, and the shading is capable of much refinement, so that very delicate tissues can be faithfully delineated. Unless the drawing consists entirely of fine lines without shaded tints, the use of hot-pressed or perfectly smooth paper is not to be recommended, but one having a small, fine grain is to be preferred. The paper should always be supported behind on some hard substance, otherwise the pencil-point will cut in, the line be difficult to rub out, and also much of the power of guiding the pencil lost. For delicate drawings, a piece of thick plate-glass makes an admirable drawing-board. The blocks or solid sketch-books so much used in out-door sketching when made of a suitable paper, are particularly pleasant and convenient to draw upon. For shading, the pencil should not be cut to a sharp point, but rather kept square. Those with extra thick leads (such as BBBB and EHB) may sometimes be used to advantage, and even the broad, flat crayons known as Harding's tablets. For general outlining with camera or ruled di-c, HB, from its freedom, will be found useful. For a fine outline, H should be used. Delicate tints may be obtained by rubbing on black-lead powder with a leather stump; the most convenient is that known as "Harding's." The author has found no black-lead pencils equal to those made by Mr. B. S. Cohen; they are very even in texture, rub out easily, do not readily break, and correspond exactly with their respective marks. The 6H, made for drawing on wood for engraving, is well adapted for the purpose for which it is intended.

Pencil drawings, and also those in chalk and charcoal, may be permanently fixed by applying freely at the back until the paper is saturated a varnish composed of white (bleached) shellac, made by mixing equal parts of white lac-varnish and methylated spirit. The white lac-varnish is always supplied by Messrs Winsor and Newton of uniform strength, and will save the trouble and difficulty of dissolving bleached lac. The drawing is to be carefully dried before a fire, and, when completed, may be rubbed with india-rubber with perfect impunity. Water colour may be freely used in combination with pencil, as it is not affected by this varnish, which does not stain the paper when dry, although it soaks in when first applied, and renders it transparent like oil.

The multiplication of microscopical drawings is a subject worthy of the attention of every observer. With the exception of Dr. Beale,* no writer on the microscope has given any account of the various processes of engraving; and yet, unless the microscopist can command the services of the very few engravers and lithographic artists who have devoted themselves to the re-production of microscopical subjects, there is, as the author has found by experience, great risk of misinterpretation.

Photography is capable of copying drawings with great exactness, and has no fault saving its cost. When only a small number are required, it would probably, however, be cheaper than any of the printing processes.

The printing processes proper consist of plate and surface printing and lithography.

Copper and steel plate engraving consists of cutting lines in a metal plate with a pointed steel tool of square or rhomboidal section, known as a graver. The plate, when finished, is rubbed over with a thick printing-ink, which is afterwards cleaned off, leaving the lines full (Fig. 45 B, 1). The plate is then passed through a powerful rolling-press with a sheet of thick, porous paper over it, which is forced into the lines, and takes the ink out of them, forming the impression (Fig. 45 B, 2). Instead of excavating the lines with a cutting tool, the plate may be covered with a preparation capable of resisting acids, known as etching-ground. The copper is then laid bare by scratching through the ground with a suitably-mounted needle. Diluted nitric acid is poured on the plate, and allowed to corrode the metal. When sufficient depth is obtained, the acid is poured off. Those lines which are "bitten" sufficiently are filled up with varnish. The process of biting is then repeated until the deepest lines are sufficiently corroded. This process of *etching* is a great favourite with artists, and might, no doubt, be turned to account for microscopical purposes, as it is much easier than using the graver, which is a very troublesome tool. The disadvantage of plate printing is that the obtaining of impressions is expensive, and the number limited, owing to the rapid wear of the plate; this latter objection, however, may be overcome by copying the plate by electrotype. The variety of engraving known as mezzo-tint is well adapted for the representation of tissues; but it requires a skilled engraver, and the learning of it would take up too much of the observer's time.

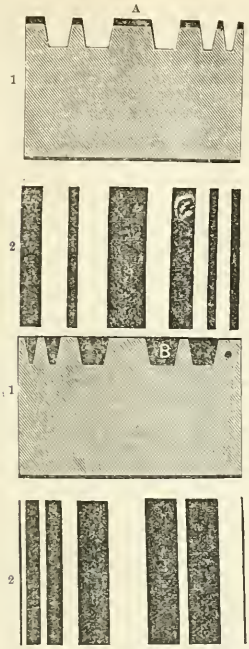
Surface printing is the reverse of plate printing. In this, as will be seen (Fig. 45 A, 1), the light parts are excavated and the dark parts left standing; these receive the ink from the roller, and yield a copy to a sheet

* The substance of a course of lectures delivered to the members of the Quekett Microscopical Club, January—April, 1869.

* "How to Work with the Microscope," pp. 28—35.

of paper upon pressure being applied (Fig. 45 A, 2). Common type is an example of this kind of printing For art purposes, wood-engraving is employed. The drawing is made on a block of box-wood, which is then

Fig. 45.*



placed in the hands of the engraver, who cuts away the light portions, leaving the solid black (if any) standing, and variously modifying, by lines and dots, the portions which have a tone between black and white "half-tints." The process is a difficult one, requiring great skill, which is only to be acquired by very long practice. It is capable of rendering microscopical subjects with great perfection: the re-productions of Dr. Beale's drawings in his various papers, by Miss Powell, are marvels of delicacy. Some beautiful specimens of wood-engraving will also be found in the work on the microscope by the late Richard Beck. Wood-engraving has the advantage of being cheaply printed, and also of being set up along with type, although, in the latter case, its beauty is somewhat sacrificed: it never has justice done to it unless it is printed by itself, and with very great care. A valuable little book on the "Art of Wood-Engraving," by T. Gilks, is published by Messrs. Winsor and Newton.

A very ingenious printing process, known as *graphotype*, has been lately brought forward. In this, a quantity of finely-powdered chalk is compressed into a solid tablet; this is drawn upon with a fine brush charged with an ink which hardens the chalk wherever it touches. The drawing is then sent to the patentees, who brush away the chalk, leaving the lines standing. A mould is made in plaster of Paris, from which a cast in type-metal, capable of yielding impressions in the common printing-press, is taken. Every facility is afforded by the Graphotyping Company, No. 7, Garrick Street, W.C., to persons wishing to test the merits of the process.

Lithography printing remarkably from all the processes of multiplying impressions just described. While, in plate and surface printing, it was essential that there should be a difference of level between the parts intended to print light and dark, in the various lithographic processes, light and dark are all printed from the same surface. The operation is purely a chemical one, and depends upon the mutual repulsion of oil and water. The stone used is a fine-grained and very compact limestone, capable of bearing a high polish, principally supplied from quarries at Solenhofen; and it would seem that it was destined to transmit natural history information to posterity, as many of the slabs enclose fossil-insects, as perfectly preserved as if they had been shut up between the leaves of a book for a few weeks, instead of ages. The British Museum has a very large collection of these specimens of Nature's lithographs. If a grease-mark be made upon the smooth surface of this or similar stone, and it then be wetted, it will be found, upon passing a roller charged with printing-ink over the stone, that the ink will adhere to the greasy portions, while it will be repelled by the parts that are wet. If the stone, with a sheet of paper on it, be passed under the press, an impression will be obtained; and, by a series of wettings and inkings, the operation may be repeated any number of times. This is the foundation of all the lithographic processes, which are numerous, and suited to the production of a great variety of effects, mostly by the use of means differing less from the ordinary manipulations of the artist than any of the other means of multiplying drawings. The use of grease or oil as a material for drawing upon stone is open to many practical objections; therefore, a greasy material is manufactured, more closely resembling, in form, that used in the ordinary process of drawing. It is composed of a mixture of tallow, soap, wax, and shellac, with a portion of lamp-black, to give it sufficient colour to guide the artist in making his drawing. The proportions vary according to the purpose for which it is required, and the combination of the materials is a matter of very nice manipulation. It can be procured, properly prepared, of the dealers in lithographic materials, and will be found in the form of crayons of three degrees of hardness, which are used like ordinary artists' chalks, and cakes, which are soluble in water, and can be rubbed down like Indian-ink, care being taken to use distilled or very pure water, otherwise, from the soapy nature of the ink, it will not mix freely.

In making drawings with the ink, a fine brush or suitable steel pen may be used; and, if the drawing is to consist entirely of ink-work, a polished stone should be employed. Care should be taken not to touch the stone with the fingers, as every greasy mark, although invisible when made, will print when the stone is rolled in. If the crayons, or chalk, are used, the stone should be what is called "grained," that is, its surface should be prepared with a texture somewhat like that of drawing-paper, to enable the chalk to be rubbed off the crayon and held by the stone. The fineness or

* We are indebted for this woodcut to Messrs. Winsor and Newton.

coarseness of the grain must be suited to the nature of the drawing: microscopical drawings usually require a very fine grain. The manipulation is somewhat like that of pencil and chalk drawing on paper, only taking certain precautions rendered necessary by the nature of the material. All light tints should appear darker on the stone than they are intended to print, as they lose some of their strength in the preparation which the stone undergoes before it is printed from. Dark tints should be worked up gradually, by repeating the touch of the chalk in as many directions as possible, so that the minute papillæ, or roughnesses, which form the grain of the stone may be loaded with the chalk on all sides, and consequently suffer less in the etching process. Any attempt to produce a dark tint or spot by a vigorous and sudden touch, as in pencil drawing, will generally fail when the stone is printed. Ink outline may often be used with great advantage in combination with chalk shading. In this case, the outline should be put on the stone with the ink first, and the shading done afterwards, as it is difficult to see the ink outline when the stone is covered with shading, and the chalk is also likely to hinder the adhesion of the ink to the stone. Care should be taken that the work is perfect before it is sent to the printer, as but little or no alteration can be made after the proof is taken. This is one of the greatest defects of lithography, and is unlike copper-plate, where the artist goes on improving and re-touching, after a series of proofs, until perfection is attained. When the printer receives the stone, he washes it with very dilute nitric acid, which converts the soapy ink into grease, and prevents its being washed off in subsequent processes. The stone is then covered with gum-water, which adheres to the parts not touched with ink, and prepares the stone to receive the wet. Then, by a series of spongings with water and rollings with printing-ink, the stone is made ready to yield a very large number of impressions. With a little perseverance and the assistance so kindly afforded by most lithographic printers,* any person who can draw may hope, after a time, to re-produce his works upon stone with tolerable success.

Another process, capable of producing very delicate results, and well suited for microscopical purposes, is that known as engraving on stone. It is by this mode that most of the beautiful works of Mr. Tuffen West are executed. It consists in scratching the lines and dots forming the picture with a diamond-point on a highly polished stone, of which the surface has been slightly coloured, to render the marks visible. Care should be taken not to cut deeply, but only slightly to scratch the stone. The printer rubs the engraved stone with grease, which adheres to the scratches, which, when the stone is rolled in, print as black lines. This process requires much more practice than either chalk or ink drawing; but its results, when well executed, almost rival fine steel-engraving.

White-line lithography, on a black ground, is useful for representing many tissues. It is executed on a polished stone, which is prepared by the surface being covered either with a coat of lithographic ink or grease and lamp-black. The artist, with a diamond point, cuts through the black ground, taking care to lay bare and slightly incise the stone. The diamond is a very free-working tool, and obeys the hand beautifully after a little practice. This process is remarkably easy and expeditious, and is worthy of having its powers developed. Very little use has been made of it at present. It seems capable of great delicacy; and, as so many microscopical observations are made on a black ground, either with the parabola or by reflected light, this process seems to be one very well suited to the wants of the microscopist. As a compensation for the ease of execution, it would seem that black-ground lithographs entail some trouble on the printer, as the fine lines are apt to fill up; but as this kind of printing becomes more frequent in use, doubtless the difficulty will be thought much less of. The author strongly recommends microscopists who have drawings to publish, and who cannot afford the cost of professional assistance, to master some one or other of the lithographic processes. Their work will doubtless, even after some practice, be rough, and not equal to the productions of experienced lithographic artists; but it will have an advantage which is possessed by no copy of a drawing, however good: it will be an autograph, reproducing all the author's peculiarities of style, and preserving those points which are very often lost in the copying of drawings by those who are not familiar with the subjects represented.

The student who wishes to render the microscope really valuable to him must determine, after mastering the technical difficulties of his instrument, to apply himself diligently to the study of some particular subject. One of our greatest authorities (Dr. Carpenter) speaks of "microscope power running to waste" in this country. Another author says:—"We have the best microscopes in the world, and the fewest observations." And it is to be feared that there is much truth in these statements. The microscope is, in the hands of many persons, only a costly toy. It should be regarded rather as a tool, and the naturalist's most efficient one. The work of the microscope does not consist in resolving the striæ of difficult diatoms; this has been done over and over again, and yet we seem to be not much nearer the truth than before. However, if we cannot understand the markings of the diatoms, they have done us service: they have caused our instruments to be continually improved, till now it is doubtful whether much more advance can be made.

The beginner is strongly recommended to go carefully through the tables at the end of Dr. Beale's "How to Work with the Microscope," carrying out the principles there laid down; for, though the work is principally written for students of anatomy and physiology, it may be consulted by all enquirers with great benefit. Great progress may always be made if the student has the good fortune to be acquainted with some working microscopist. Many such are glad of the assistance of others; and, although the beginner may not be able to originate an enquiry, he may confirm and verify the observations of others, and, in so doing, add largely to his own stock of knowledge.

The numerous microscopical societies in London and elsewhere offer great facilities to the young student, by giving him opportunities of becoming acquainted with the best practical microscopists. Many of the societies have regularly organised collecting-excursions, under the direction of experienced persons. By attending these meetings much information may be gained.

The recent application of the spectroscope to microscopical research will no doubt be a very promising field of enquiry. Already, besides other discoveries, the distinction between two vegetable reds (those of the

* The author has been much indebted to the artists in the office of Mr. West, Hatton Garden, for much valuable information.

grape and elder-berry) has been pointed out by its means, and will probably lead to the detection of methods of adulteration which have hitherto baffled both chemists and microscopists; and many more very important results may be expected to be elicited by steady application and careful use of this most delicate means of distinguishing colour. The use of the microscope is far from being confined to those sciences which are connected with natural history. The instrument has been applied, with the greatest advantage, to researches on inorganic matter; and much valuable information has been obtained by the observations of Mr. Sorby and others who have devoted themselves to such enquiries.

ON THE

ACTION OF BROMINE UPON ETHYLBENZOL.*

BY T. E. THORPE, PH.D.

In the course of an investigation upon ethylbenzoic acid, which Professor Kekulé and the author recently published, they had occasion to prepare a quantity of monobromethylbenzol, $C_6H_4Br \{ C_2H_5$, the object being to prove, experimentally, the identity of the ethylbenzoic acid made synthetically by acting upon monobromethylbenzol by means of carbonic anhydride and sodium with the acid subsequently obtained by Fittig by oxidising diethylbenzol by means of nitric acid. The authors, while preparing the bromide they required for their experiments, followed the directions given by MM. Fittig and König. The action of bromine upon ethylbenzol is very energetic, and the last-named substance has to be strongly cooled. The resulting product was submitted to fractional distillation; at 145° the liquid commenced to boil, and a comparatively large quantity passed over between 150° and 160°; but the greater portion came over between 180° and 190°. An analysis of that portion showed it to contain very nearly the theoretical amount of bromine calculated for C_8H_9Br; this compound is very unstable. On renewed distillation, it was found to begin to boil at 140°, and, unless the distillation is very rapidly conducted, a large proportion is transformed into styrol and hydrobromic acid; this difficulty is met, however, by distillation *in vacuo*. The bromide thus obtained is a heavy colourless liquid, boiling nearly constantly at 148° to 152°, and possessing a characteristic penetrating odour. When heated with solutions of ammonia or potassa in alcohol, it gives up its bromine with the greatest facility. The author points out the very great difference of properties discovered by him to exist between the monobromethylbenzol described by M. Fittig and that obtained by him and just alluded to, and reasonably concludes that these substances, although prepared under conditions apparently exactly similar, are not identical. The compound obtained by the author is identical with that obtained by Berthelot by acting upon boiling ethylbenzol with vapours of bromine, and the formula of that substance is $C_6H_5 \{ C_2H_4Br$.

The larger portion of the contents of this paper is further devoted to the description of the experiments made to discover the cause of the variation in the position of the bromine atom. As the result of these experiments, some new substances were obtained; among these, styrolylethyl-ether, a colourless, mobile, fragrant-smelling liquid, boiling constantly at 187° (sp. gr. at 21·9°, 0·931), slightly soluble in water, and burning with a strongly-luminous flame.

The author describes, at great length, the different operations and manipulations applied by him, but space forbids us to enter into more details on this subject.

* Abstract of a paper communicated to the Royal Society.

ON THE

SUPPOSED NUCLEATE ACTION OF WEAK SOLUTIONS OF GLAUBER'S SALT

ON

SUPERSATURATED SOLUTIONS.

BY CHARLES TOMLINSON, F.R.S.

A gentleman, under the signature of "A Constant Reader of the Chemical News," has written to me respecting my theory of the action of nuclei on supersaturated solutions,* and states that this theory does not meet the case given by M. Jeannel,† in which a supersaturated solution (say of Glauber's salt) filtered into a flask, is protected by leaving the funnel and the filter in the neck of the flask; so that when cold, an ordinary solution of the same salt being poured upon the filter, produces crystallisation as soon as it reaches the supersaturated solution.

The objection is—(1) that, in such a case as this, there can be no nucleus derived from the air, and (2) that the liquid which causes the solution to crystallise is chemically clean.

While engaged in studying the subject of supersaturated solutions, I read M. Jeannel's paper with much interest, and repeated his experiments with such variations as the nature of the case seemed to require. My conclusion was that, if the experiment be conducted with proper attention to cleanliness, and care to exclude nuclei, a solution of Glauber's salt may be allowed to fall upon a cold supersaturated solution of the same salt without inducing crystallisation.

So long as I adopted M. Jeannel's form of experiment, I always obtained his result—namely, a separation of the salt from the supersaturated solution. But this form is objectionable, because, by leaving the funnel and filter exposed during many hours to the air, active nuclei become accumulated on it, and some of them are sure to be dragged down with the solution into contact with the contents of the flask. In like manner, a crystal taken up between the finger and thumb, or even by mere exposure to the air, is said to be an active nucleus in crystallising a supersaturated saline solution of its own kind; but I have already proved ‡ that, if care be taken to make the crystal chemically clean, it is possible to bring it into contact with a highly-supersaturated solution, and to leave it there for days, and even months, without any separation of the salt.

M. Jeannel's position is that drops of a solution of a salt, allowed to fall upon a supersaturated solution of the same salt, will cause it to crystallise. In testing such a proposition, I am, of course, allowed to adopt my own means for conveying the drops to the solution, and, provided they reach it and fall upon it, the case is met, even though the funnel and filter be dispensed with.

My method of conducting the experiment was this:—A solution of Glauber's salt was filtered into a clean

* Chemical News, vol. xix., p. 267; *Am. Repr. Aug.* 1869, *page* 69.
† *Ann de Ch. et de Ph.* 4 Ser., t. vi., p. 166.
‡ Chemical News, vol. xviii., p. 110; *Am. Repr. Nov.* 1868, *page* 231.

flask, in which it was boiled up again; and, while boiling, a clean, straight dropping-tube, closed by means of a cork at the top, and passing through a disc of vulcanised india-rubber, was put into the flask, so that its point dipped below the surface of the solution. The heat expanded the air of the tube, and a considerable quantity of it escaped in bubbles. When the lamp was removed, an equal volume of the solution entered the tube, which was then pulled up about an inch, so as to be out of, but over, the solution. The india-rubber disc protected the solution from the entrance of nuclei, but, as a further precaution, each flask was covered with a bell-glass. In this way, the solutions can be kept as long as may be required without crystallising. On taking off the bell-glass and gently loosening the cork (a stop-cock would have been better), the solution fell from the tube in drops, but there was no separation of salt.

Two solutions were next made, the one containing 1 part of salt to 1 of water, and the other 2 parts of salt to 1 of water. Each flask contained a tube, passing through an india-rubber disc, as before; and, when the tubes had taken up a quantity of the solution, they were changed—that is, the tube containing 1 salt to 1 water was put into the flask containing 2 salt to 1 water, and *vice versâ*. When the solutions were cold, the corks were loosened. The drops produced much disturbance in the internal viscosity of the solutions, but there was no crystallisation.

In another experiment, the solution containing 1 salt to 1 water was allowed to drop into a solution containing 3 salt to 1 water, and this into the solution of 1 salt to 1 water. The solutions were prepared over night, and, as the night was cold, the flasks, as well as the tubes, contained portions of the modified salt, so that crystals as well as drops fell into the solutions; but still the solutions did not crystallise: on taking out the tubes, they did so immediately, the nuclei being, of course, derived directly from the air.

A still weaker solution (namely, 1 salt to 3 water) was allowed to drop into a supersaturated solution containing 2 salt to 1 water; but there was no separation of salt.

Hence it will be seen that, if proper precautions be taken to exclude nuclei, a solution of Glauber's salt does not act as a nucleus to a supersaturated solution of the same salt.

Supersaturated solutions of potash-alum, treated in the same way, lead to the same result. I have no doubt that similar solutions of other salts would lead to the general conclusion that solutions of salts do not act as nuclei to their supersaturated solutions.

Highgate, N., Jan. 29th, 1870.

ON THE DECOMPOSITION OF SALTS OF SESQUIOXIDE OF IRON.

BY M. H. DEBRAY.

If a solution of neutral chloride of sesquioxide of iron, so much diluted that its colour is scarcely perceptible, be heated, the liquid will be seen, after arriving at 27°, to become strongly coloured and assume the characteristic hue of sesquioxide of iron. This change is not owing to the evolution of a certain quantity of chlorhydric acid, for it is effected in close vessels, and, after cooling, the liquid retains its primitive acid reaction and the colour which it has received from the heat.

The chemical properties of the salt of iron are greatly modified: the original liquid gives with yellow cyanide a precipitate of a deep Prussian blue colour, whilst the coloured solution with the same reagent yields only a pale greenish blue precipitate, and saline solutions of sea-salt for instance, without acting on the ordinary chloride, produce in the modified chloride a gelatinous precipitate of hydrated sesquioxide of iron. This oxide, when immediately washed, re-dissolves in the water and contains only small quantities of salt, but it loses the property of solubility if it be allowed to digest a day or two with its precipitant. The modified solution when dialysed gives chlorhydric acid almost entirely exempt from iron, which passes through the paper and from soluble oxide of iron which remains in the dialyser.

The chloride of iron separates at about 70° into chlorhydric acid and sesquioxide of iron, soluble in water and in diluted chlorhydric acid, insoluble in most saline solutions: these are precisely the characteristics of colloidal oxide of iron obtained by Mr. Graham in the dialysis of basic solutions of iron.

It is not supposed that chloride of iron separates into chlorhydric acid and basic chloride, because the existence of these basic soluble compounds appears scarcely reconcilable with the fact of their decomposition by the septum in dialysis, or by the sea salt which precipitates pure oxide of iron.* It would seem more natural to consider these compounds as solutions of colloidal oxide of iron in chlorhydric acid, or, at least, in common sesquichloride of iron.

On heating on a water-bath, at 100°, a diluted solution of sesquichloride of iron, and carefully replacing the evaporating liquid, the soluble oxide is gradually changed into the isomeric modification of sesquioxide of iron discovered by Pean de Saint-Gilles. It will be remembered that this chemist by subjecting acetate of sesquioxide of iron in solution to the prolonged action of heat obtained a particular oxide insoluble in dilute mineral acids and in most alkaline solutions, and yielding, when mixed with water, a liquid transparent to transmitted light and turbid on reflection.

Some years later, M. Scheurer-Kestner demonstrated that the decomposition of nitrate of iron would also furnish it. According to my experiments, the production of Pean de Saint-Gilles's oxide is due to the same cause. The first effect of heat upon salts of iron with monobasic acid is to separate them into acid and oxide, which only remain separate if the acid is diluted; the next is to transform the soluble oxide into the metasesquioxide of Pean de Saint-Gilles, which differs by its state of hydration and by several of its characteristics from the colloidal oxide of Mr. Graham. Solutions of bibasic acids, like the sulphate, yield only insoluble sub-salts when submitted to the action of heat.

If De Senarmont's method be used, namely, by decomposing chloride in a diluted solution at a temperature varying from 250° to 300°, at which colloidal oxide and metasesquioxide no longer exist, the separation of the acid and oxide necessarily occur, since a temperature of 70° only suffices to effect it. The oxide, which is produced very slowly, is anhydrous sesquioxide and crystallised, that is to say, oligistic. It is unnecessary to explain the experiment of De Senarmont to introduce the influence of pressure upon the closed tube in which the experiment is made by steam strongly heated, or by an evolution of chlorhydric acid.

* This reaction of alkaline chlorides on basic chlorides was noticed for the first time by M. Béchamp (*Ann de Ch. et Phys.*)

Iron may be separated from manganese by a well-known method, as follows:—First transform the metals into chlorides; then bring the iron to the maximum of oxidation; and, after incompletely saturating the excess of acid by carbonate of soda, an excess of acetate of soda is added to the boiling liquid. The sesquioxide of iron is precipitated alone in the acid liquid. The theory of this reaction is very simple. The acetate of sesquioxide of iron, formed of a mixture of chlorides and acetate of soda, separates, on boiling, into acetic acid and colloidal oxide, insoluble in a liquid containing a notable quantity of sea-salt and acetate of soda. When washed quickly in cold distilled water, a large portion of the oxide re-dissolves; this may be avoided by washing it with a diluted solution of chlorhydrate of ammonia. It will also be easy to introduce into the liquid containing the chlorides only volatile reagents, acetate of ammonia, which produces the same effect as acetate of soda, because colloidal oxide of iron is insoluble in an ammoniacal salt, even in the presence of a large quantity of acetic acid. The separation of oxides of iron and manganese is as perfect as possible by this method; but it is preferable for exactitude in weighing the oxide of iron to pour the solution of acetate of ammonia into a hot solution of nitrates of the two bases, and to wash the oxide with a warm solution of nitrate of ammonia. The loss of iron consequent upon the action of the ammoniacal salt upon oxide of iron during calcination is thus avoided.

Aniline is actually prepared (after M. Béchamp's method) with nitrobenzol, iron, and a quantity of acetic acid much smaller than that of the quantity of sesquioxide formed. The acetate of peroxide of iron, having but little stability at the comparatively high temperature of the reaction, is decomposed into insoluble sesquioxide of iron, and into acid capable of again reacting on the metal. A small quantity of acetate of aniline should also be formed; but, if the tension of dissociation of this salt is sensible at the temperature of the experiment, it necessarily follows that a small quantity of acid will suffice to terminate the reaction.—*Comptes Rendus.*

ON THE SEPARATION OF IRON AND ALUMINA.

BY E. W. PARNELL.

Of the many methods proposed for the separation of iron and alumina effectively, no one seems to combine the very necessary qualities of accuracy and simplicity. The method of weighing the two oxides together, and then separating the alumina by fusion with caustic soda and subsequent treatment with water, is, no doubt, exceedingly accurate, but troublesome. In an accurate analysis, an analyst avoids, if possible, volumetric estimations. The plan of effecting the separation of the iron by means of sulphide of ammonium from the ammonio-citrate solution of the oxides cannot give perfectly accurate results, since the sulphide of ammonium has the power of holding up small quantities of iron in solution; this may be proved by letting the perfectly-clear filtrate stand a few days, when small flakes of sulphide of iron will be deposited.

The method about to be described (proposed, I believe, by Prof. Bunsen, of Heidelberg) is in use in some laboratories on the Continent. I have never seen it published in English, and it may possibly be new to some of your readers. To the slightly acid solution of the oxides a solution of hyposulphite of soda is added, more than equivalent to the amount of free acid present. The liquid is then boiled in a flask for about ten minutes or a quarter of an hour. The whole of the alumina will be thrown down in a fine granular state, together with the sulphur resulting from the decomposition of the hyposulphurous acid; while the whole of the iron will remain in solution. The liquid is then rapidly filtered, and the precipitate washed with boiling water, dried, ignited in a porcelain crucible, and weighed in the usual manner. The filtrate containing the iron is treated with hypochlorite of soda, nitric acid, or other oxidising agent, and the iron estimated by precipitation by ammonia and weighing as sesquioxide. Care should be taken to avoid large excess of acid, in the first instance, and also, subsequently, of the hyposulphite: the smaller the proportion of sulphur with the precipitated alumina, the more easily may it be filtered off from the iron solution. After calcination, the alumina appears as a perfectly-white, crystalline powder, much resembling precipitated and calcined silica.

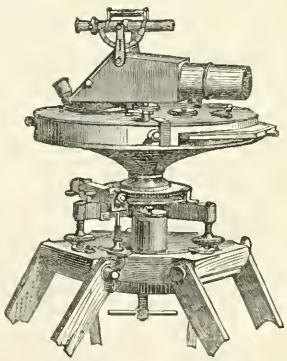
Alumina might probably be separated by this method from other metals—such as manganese, zinc, &c.; and, were phosphoric acid present, it would probably be carried down with the alumina. I have not, however, experimented on these points.

Runcorn Soap and Alkali Works,
Runcorn, Jan. 27th, 1870.

PHOTOGRAPHIC PLANE-TABLE.

We have received through the kindness of Mr. James Swaim, a pamphlet on the above instrument, invented by M. Auguste Chevalier, containing full descriptions of its working and construction, and illustrated by engravings and a photograph.

The accompanying woodcut represents an exterior



view of the apparatus as given by the photograph. It consists of a photographic objective, behind which is placed a square prism, by total reflection from whose oblique rear surface, the image formed by the lens is projected upon an horizontal sensitive plate set beneath. The lens and prism, as well as an opaque screen covering the plate with the exception of a narrow slit in a

plane passing through the axis of the lens and the centre of motion, rotate about a vertical axis in the middle of the instrument, being driven by appropriate clock-work. By this means, when the instrument is placed at one end of a base line, adjusted, furnished with a sensitive plate, and allowed to make a total revolution, it will produce an automatic photographic horizontal projection of all objects within the panoramic field, from which their various angular relations may be determined with the greatest accuracy. It might seem that sharpness of definition was incompatible with a continuous motion of the lens, but the admirable panoramic pictures produced by the apparatus of Martens and of Garella, which operate on the same principle, are a complete and satisfactory answer to this objection.—*Journal of the Franklin Institute.*

ON BAUMÉ'S AREOMETER.

BY M. BAUDIN.

Sundry divergences occur in Baumé's areometer, according to different authors. Upon examining this instrument, I found the figure given for 85 parts of distilled water and 15 parts of pure and well-dried chloride of sodium to be 1·111 absolute density at 15°. Francœur found 1·109; Soubeiran, 1·116; Terlach, 1·114; and M. Coulier, Professor of Chemistry, gives 1·110725. The work of the latter may be considered as the most important of those upon the subject.

Repeated experiments have convinced me that the figure of density 1·111 is most correct; I have, therefore, employed it to re-construct the actual scale of Baumé. The figure, 1·116, given by Soubeiran, does not correspond with Baumé's formula (85 parts of water and 15 of salt), and indicates that the instrument marks 66° in a sulphuric acid whose point of concentration is undefined; this arbitrary scale is by no means that of Baumé. Serious results arise from these discrepancies—manufacturers are uncertain as to which Baumé-areometer they should trust, and endless disputes ensue. Brisson's densimeter should be the only one employed, as any one can manage it.

Comparison of Baumé's Scale (Acidimetric) with the Scale of Density.

Baumé. Degrees.	Francœur. Density.	Baudin. Density.	Soubeiran. Density.
0	1000	1000·0	1000
5	1034	1034·4	1036
10	1070	1071·3	1075
15	1109	1111·0	1116
20	1151	1153·8	1161
25	1196	1200·0	1210
30	1245	1249·9	1262
35	1299	1304·2	1320
40	1357	1363·5	1383
45	1420	1420·4	1453
50	1490	1500·0	1530
55	1567	1578·9	1615
60	1652	1666·6	1711
65	1747	1764·6	1819
70	1853	1875·0	1942

ON ORGANIC MATTER IN THE AIR.*

BY DR. R. ANGUS SMITH, F.R.S., &c.

I have worked and written so constantly on impurities in air and water that last year I was told by a periodical of high position that I was quite regardless of the impression made on timid persons, and I began to compare myself to a collector of "varieties," who is often obliged to bring up his curiosities every five years. When I read of the new experiment by Professor Tyndall, showing to the naked eye the numberless bodies in the air, I was abundantly gratified, as I obtained them only by a laborious although simple process. When, however, Dr. Tyndall began to show the character of these bodies, it "smote the chord of self," as I imagined that I had long ago proved that not only organic and inorganic, but organised, forms exist in the atmosphere. Neither do I claim this as my original idea, looking rather to the fulness of proof and quantitative results as mine. I think, therefore, I may remind my friends of some of my work, as I find that they forget; and even I forget the exact words used by myself, and must read up.

But, as people do not read much on a subject, I will begin at the end. I have been for two years attempting to measure the amount of putrescible matter in the air of the towns and country-places; and I have succeeded to a considerable extent. I also measure the amount that has putrefied and left its remains in the air—the sewage of the atmosphere. Some of my results are published. I have promised some very soon, and some have been ready for printing, under the head of "Chemical Climatology." The proof of organic matter is old. I seek the quantity in various towns and parts of towns.

I shall not here give a history of the enquiries. So many people claim to have something to say in the matter, that I might amuse myself, if not the public, by a long account. At present, I profess to keep almost entirely to my own work. The knowledge of organic matter in the air has never been absent entirely from men's minds in historic times; but the words of Bishop Berkeley are so clear that I prefer to quote them; besides, he is far enough back for the purpose. He says, in "Siris" (par. 140):—

"Nothing ferments, vegetates, or putrefies without air, which operates with all the virtues of the bodies included in it—that is, of all nature. . . . The air, therefore, is an active mass of numberless different principles—the general sources of corruption and generation; on the one hand, dividing, abrading, and carrying off the particles of bodies, that is, corrupting or dissolving them; on the other, producing new ones into being, destroying and bestowing forms without intermission."

And, in paragraph 141, he says:—

"The seeds of things seem to be latent in the air, ready to pair, and produce their kind whenever they light on a proper matrix. The extremely small seeds of ferns, mosses, mushrooms, and some other plants, are concealed and wafted about in the air, every part whereof seems replete with seeds of one kind or other. The whole atmosphere seems alive. There is everywhere acid to corrode and seed to engender. Iron will rust, and mould will grow in all places."

No man has, before or after him, expressed this truth more completely and beautifully. It is hard to improve it by one word. Still, this age demands more detailed knowledge and exact theory. Besides, the work of every few years requires to be done again, to suit modern methods, although it must be confessed that there is room for the cynic to say that Bishop Berkeley and all the ancients and moderns might be classed with Topsy, who think they have explained all by saying—"It grows."

* Read before the Manchester Literary and Philosophical Society, Jan. 25th, 1870.

I began to examine the air in 1846, and I brought a short notice before the Chemical Society: a simple mode of obtaining organic matter in the condensed breath on windows is recorded in their transactions. On account of this commencement, which promised favourably, the British Association requested me to report on the subject. My report, published in 1848, was considered to have made advance, and was marked out for special mention by the President of the succeeding year, so that the words were not hidden. I quote a part, "That animals constantly give out a quantity of solid organic matter from the lungs, may readily be proved by breathing through a tube into a bottle, when the liquid or condensed breath will be collected at the bottom of the bottle; or by breathing through a tube into water, when a solution of the same substance will be found in the water. This would scarcely require proof if we consider that breath so frequently has an organic smell."

"If this condensed breath be put on a piece of platinum, or on a piece of white porcelain and burnt, the charcoal which remains and the smell of organic matter will be conclusive. If it be allowed to stand for a few days (about a week is enough), it will then show itself more decidedly *by becoming the abode of small animals.* These are rather to be styled animalculæ, and very small ones certainly, unless a considerable quantity of liquor be obtained; they may be seen with a good microscope. Animalculæ are now generally believed to come from the atmosphere and to deposit themselves on convenient feeding places; that is, they only appear where there is food or materials for their growth, and they prove of course the existence of that continuation of elements necessary for organic life. At the same time their presence is a proof of decomposing matter, as their production is one of the various ways in which organised structure may be broken up."

"I mentioned some time ago that I had got a quantity of organic matter from the windows of a crowded room, and I have since frequently repeated the experiment. This matter condenses on the glass and walls in cold weather, and may be taken up by means of a pipette. If allowed to stand some time it forms a thick, apparently glutinous mass; but when this is examined by a microscope, it is seen to be a closely matted confervoid growth; or, in other words, the organic matter is converted into confervæ, as it probably would have been converted into any kind of vegetation that happened to take root. Between the stalks of these confervæ are to be seen a number of greenish globules constantly moving about, various species of Volvox, accompanied also by monads many times smaller. When this happens the scene is certainly lively and the sight beautiful, but before this occurs the odour of perspiration may be distinctly perceived, especially if the vessel containing the liquid be placed in boiling water.

"If air be passed through water a certain amount of this material is obtained, but I have found it difficult to pass a sufficient quantity through. If it is made to pass rapidly, *absorption does not take place*, and evaporation of the water is the consequence; if it passes slowly, it requires several weeks to pass a 100 cubic feet through a small quantity of water. I continued the experiment for three months, but although I obtained sulphuric acid, chlorine, and a substance resembling impure albumen, I did not get enough to make a complete examination; and indeed this could not be expected, as I found that in that time less than 1000 gallons of air had passed through.

"When this exhalation from animals is condensed on a cold body, it, in course of time, dries up, and leaves a somewhat gelatinous organic plaster. We often see a substance of this nature on the furniture of dirty houses, and, in this case, there is always a disagreeable smell perceptible."—*Mems. Brit. Association Meeting, held in August*, 1848.

I quote the words used by the President of the Association simply to show that the paper was well known:—

"For instance, the causes which, in our great cities, hasten the death and debase and embitter the life of so many have at last been forced by chemists and physiologists on the notice of the public. Look at Dr. Smith's report on the air and water of towns in this volume; and, when we think that the victims of the deadly influences which are there revealed are chiefly found among the people whose industry is the foundation of our greatness,—that every year cut off from the life of each of these is so much subtracted from national wealth,—even were all moral senses and religious feeling dead in us, we must confess that the knowledge which is capable of averting them 'is of use.'"

Looking over these words at this distance of time, it seems to me scarcely possible to write more clearly, although some of the words I should prefer to see changed. Still, the subject was a continued study, and it was my strong desire to measure exactly the amount of organic matter. Not to detail all the attempts, I may come to the report to the Cattle Plague Commission in 1866, in which I give some general views and allude to the works of others. The following may be quoted:—

"It has often been asked—Will a sewer produce cholera, or plague, or cattle disease? We cannot say so, or that every kind of disease may be produced from such accumulations of organic matter. The great epidemics that have passed over Europe seem always to have come from some extraneous source, to act *as if planted by some seed*, and not to have risen up spontaneously here. Without attempting to examine this matter carefully, the result would seem to be that, whilst the decomposition of organised beings after death produces gases and vapours that are opposed to health, these gases or vapours are incapable of originating, although they may be capable of feeding, some of those diseases, such as cholera or plague, which have been observed at all times to come from a warmer climate. There must, however, be some first origin of these diseases; and we cannot prove that the first origin might not take place in our climate, although it seems probable that it requires a warmer sun and a richer vegetation than is to be found in the north. This, however, is sufficiently made out—that, when these diseases do come amongst us, they take root with most effect in those places where decomposing matter is found. If we were to suppose a seed of disease planted in a rich, fertile soil of decomposing matter, we should give a pretty fair description of the fostering effect of impurity on disease. It would, in fact, appear as if the putrid matter itself took the disease, and transferred it to the living. There seems to be nothing entirely opposed to this view of the case. The question, however, is, and has always been—What is the nature of that substance which may be said to form the seed, or germ, of the disease? Chemists have been inclined to consider it a substance in process

of decay, as the quotation from Liebig already given shows. Physiologists and microscopists have been more inclined to consider it as an organised substance. When Gay Lussac passed a bubble of air into the juice of grapes, and found that fermentation began at once, it was believed that the oxygen was the prime mover, and that when once begun, the action did not cease. When, however, Dusch and Schroeder found that flesh did not decompose if the air was previously passed through a good filter of cotton wool, some difficulty was thrown on the subject. It would appear as if oxygen were not the only agent in the atmosphere causing decomposition. The investigations of M. Pasteur, who found the subject in this uncertain condition, have advanced it so far that we may now with certainty reason in the belief that organised substances are really found in great abundance in the atmosphere (in all places), and that they are the cause of some hitherto entirely mysterious phenomena, putrefaction included. His object was first to inquire into the possibility of spontaneous generation, and he found that carefully filtered air allowed no organisms to appear in vegetable solutions. He found that near the usual surface of the ground these organisms were so numerous that whenever a vessel containing vegetable matter fit for their growth was opened for a very short time they were found to enter, that in cellars and damp and quiet places, where there was no air or dust floating about, these organisms were fewer, and that, as he ascended the sides of the Alps and the Jura, they diminished in number. A commission of the French Academy confirmed his results. If we examine previous inquiries into the compounds resulting from the decomposition of organic substances, we shall find nothing which is at all calculated to bring out such an intelligible rational view of the origin of many diseases, and also of some phases of putrefaction. Chemists, when they have examined products of the latter action have found sulphuretted hydrogen, carburetted hydrogen, hydrogen, carbonic acid, nitrogen, hydrogen, ammonia, acetic acid, lactic acid, butyric acid, and numerous uncertain bodies having no activity, and utterly incapable of producing those prodigious results that are found when that force begins to work which produces plague, small-pox, or black death."

I did not enter on Pasteur's ground—the action of organisms in producing fermentation.*

After these opinions and the detail of many facts, one is mentioned which was the culminating point of the enquiry, and has led to a mode of collecting the organic particles of air, which I may call established. This word established is used because the experiment has been done by others. It is given in these few but plain words:—"The air of cow-houses and stables is to be recognised as containing more particles than the air of the street in which my laboratory is, and of the room in which I sit, and that it contains minute bodies, *which sometimes more, if not at first, yet after a time, even if the bottle has not been opened in the interval.* There is found, in reality, a considerable mass of debris, with hairs, or fine fine fibres, which even the eye, or, at least, a good pocket-lens, can detect. After making about two dozen trials, we have not been able to obtain it otherwise. Even in the quiet office at the laboratory, there seemed some indications."

* I found similar indications in a cow-house, with healthy cows. So I do not pretend to have distinguished the poison of cattle plague in these forms; but it is clear that, where these exist, there may be room for any ferment or fomites of disease; *and I do not doubt that one class is the poison itself in its earliest stage.* It would be interesting to develop it farther."

I do not detail the examination made of the condensed air brought from a cow-house by Mr. Crookes; nor do I detail the examination of the cotton through which Mr. Crookes had passed the air; nor the glycerine surfaces exposed to the air of cow-houses, which, also, was done by Mr. Crookes My object at present is, not to give a history, but a few of the prominent points, so far as relates solely to my own part.

These experiments were repeated on air in Manchester. A paper was read, on March 30, 1868, to the Literary and Philosophical Society, Manchester, Dr. Schunck in the chair. To quote a part:—

"Lately, I tried the same plan on a larger scale. A bottle of the capacity of 4·99 c.c. was filled with air, and shaken with water. The bottle was again filled, and shaken with the same water; and this was repeated 500 times, nearly equal to 2½ millions c.c., or 2.495 litres. As this could not be done in a short time, there was considerable variety of weather, but chiefly dry, with a westerly wind. The operation was conducted behind my laboratory, in the neighbourhood of places not very clear, it is true, but from which the wind was blowing to all parts of the town. I did not observe any dust blowing; but, if there were dust, it was such as we may be called on to breathe. The liquid was clouded, and the unaided eye could perceive that particles very light were floating. When examined by a microscope, the scene was varied in a very high degree—there was evidently organic life. I thought it better to carry the whole to Mr. Dancer, and to leave him to do the rest, as my knowledge of microscopic forms is so trifling, compared to his."

Having for years, therefore, convinced myself of these results, I took the air washings to Mr. Dancer, of Manchester, whose experience in microscopic objects is so great that I was certain to be corrected, if I erred; and, if I did not err, I should be taught more. His examination is very beautiful; and it shows, not only organic substances, but very many in quality, and inconceivably many as to quantity. The whole cannot be quoted; but the following will suffice:—

"The water was first examined with a power of 50 diameters only, for the purpose of getting a general knowledge of its contents. Afterwards, magnifying powers varying from 120 to 1,600 diameters were employed.

"During the first observations, few living organisms were noticed; but, as it afterwards proved, the germs of plant and animal life (probably in a dormant condition) were present.

"1. Fungoid Matter.—Spores, or sporidiæ, appeared in numbers; and, to ascertain as nearly as possible the numerical proportion of these minute bodies in a single drop of the fluid, the contents of the bottle were well shaken; and then one drop was taken up with a pipette; this was spread out, by compression, to a circle ½ an inch in diameter. A magnifying power was then employed which gave a field of view of an area exactly 1-100th of an inch in diameter; and it was found that more than 100 spores were contained in this space. Consequently, the average number of spores in a single drop would be 250,000.

"On the third day, a number of ciliated zoospores were observed moving freely among the sporidiæ.

"Some of this formed a very interesting object, with a high power; and the greater portion exhibited what

is called pitted structure. The larger particles of this had evidently been partially burnt, and quite brown in colour, and were from coniferous plants, showing with great distinctness the broad marginal bands surrounding the pits. Others had reticulations small in diameter. They reminded me of perforated particles so abundant in some kinds of coal.

"Along with these reticulated objects were fragments of vegetation resembling, in structure, hay, and straw, and hay seeds, and some extremely thin and transparent tissue showing no structure.

"A few hairs of leaves of plants and fibres, similar in appearance to flax, were seen; and, as might have been expected in this city, cotton filaments, some white, others coloured, were numerous, red and blue being the predominant colours. A few granules of starch, seen by the aid of the polariscope, and several long elliptical bodies, similar to the pollen of the lily, were noticed. After this dust from the atmosphere had been kept quiet for three or four days, animalculæ made their appearance in considerable numbers, the monads being the most numerous. Amongst these were noticed some comparatively large specimens of *Paramecium aurelia*, in company with some very active *Rotiferæ;* but, after a few days, the animal life rapidly decreased, and in twelve days no animalculæ could be detected.

"For the purpose of obtaining a rough approximation of the number of spores or germs of organic matter contained in the fluid received from Dr. Smith, I measured a quantity by the pipette, and found it contained 150 drops of the size used in each examination. Now, I have previously stated that, in each drop, there were about 250,000 of these spores; and, as there were 150 drops, the sum reaches the startling number of 37½ millions."

After these examples, the first being twenty-four years earlier than the last, I need not add that my certain knowledge is that particles both organic and inorganic are found in air.

Further, that some of the organic particles are organized.

Lime, soda, sulphates, and chlorides have been mentioned in another paper as being found, coal-ash and, of course, carbon, and to some extent the amount measured. In railway-carriages, we even breathe rolled plates of metallic iron which are large enough to be seen by the naked eye.

Some of the most difficult particles to remove are those of coal-smoke; they are oily or tarry, or both. These are instances of organic and not organized particles.

For two years I have been endeavouring to measure with certainty the amount of nitrogen in the organic matter, separating it from the inorganic. Some of the results are in the last "Report of the Proceedings under the Alkali Act," and have been pretty extensively published. Other results are soon to be published.

I have not yet spoken of my work, "On the Air of Mines," where drawings of the particles of solid matter are given (in a long report published by the Mines Commission in 1864), because the air was from exceptional places. Still, similar results are got above ground. In the small tubes containing air from the mines and solids, I was able to detect very distinctly organic matter, and to measure the ammonia.

Still, the best proofs are in the sight of actual forms and the moving objects. In finding these with many accessories, I consider their existence in the air of such places as were tried proved beyond all doubt, also long ago proved. We now require good microscopists to examine the individual forms, and to find if every disease has one peculiar to itself, as Mr. Bailey finds every class of plants has its own peculiar pollen. That is probably the next most prolific field for those who desire something more on the subject.

We must not be panic-stricken because of these forms. Some are hurtful; but it may be that others are required for the maintenance of healthy animal life of the highest order, exactly as in vegetable fermentation. We must purify the air within the limits of natural intention, and be careful that we do not overstep its boundaries.

ON SOME

REMARKABLE SPECTRA OF COMPOUNDS OF ZIRCONIA AND THE OXIDES OF URANIUM.*

BY H. C. SORBY, F.R.S.

When a scientific man has been led into an error, and afterwards discovers his mistake, I think it a matter of duty that he should take an early opportunity to correct it. I therefore now write the following notice of certain remarkable peculiarities in the spectra of some compounds of the oxides of uranium with zirconia, which led both myself and others† to conclude that they were due to a new elementary substance.

Though the spectra of the different salts of those bases which show well-marked absorption-bands often differ in detail, yet they usually resemble each other so much that there is no difficulty in recognizing each particular element. This is so constantly the case in the various compounds of erbium, didymium, and cobalt, and in the ordinary salts of uranium, that, for a long time, the more I studied this question, the more did it appear to be a general rule; and there seemed to be no reason to suspect that a few special compounds of uranium would give spectra with absorption-bands as unlike as possible those of all others. Such, however, turns out to be the fact, when its oxides are combined with zirconia.

As an excellent illustration of important differences in mere detail, but general correspondence, I would refer to the spectra of didymium in different states of combination,‡ and would especially refer to the most distinct of the numerous absorption-bands, which occurs in the yellow. The various compounds agree in showing this band in the same general position; but, by careful management, and by the use of sufficient dispersive power, it may be resolved into a very variable number of narrow bands or black lines. For example, in the case of the crystallised sulphate containing comparatively little lanthanum, it can be resolved into seven narrow lines, two of those near the centre being the darkest; whereas, when much lanthanum is present, one line on the side next the green is so much darker than the rest, that the others are comparatively absent. On fusing the mixed oxides with borax, the same spectrum is seen as with oxide of didymium alone, and I can resolve the above-named band into only two

* Read before the Royal Society, February 10th, 1870. Revised by the Author for the Chemical News.

† Professor Church's paper, Chemical News, vol. xix., p. 121, *Am. Repr. May '69, page 231*: and Professor Loew, vol. xx., p. 9; *Am. Repr. Sept. '69, page 165.*

‡ See also Bunsen's paper, *Pogg. Ann.*, vol. cxxviii., p. 100.

narrower bands; whereas, when the saturated bead is made to deposit crystals by being kept some time at a very dull red-heat, this band can easily be resolved into eight equal and very distinct black lines. Although these and similar differences, in detail, are of much interest, yet in no case are they so considerable as to prevent our recognizing at once that the spectra are all due to didymium. It is also important to notice that the amount requisite to give a most splendid spectrum, when the bead is crystalline, will scarcely show any trace of bands when in a vitreous condition, dissolved in the borax. This is analogous to what occurs in the case of solid and powdered crystals of sulphate of didymium; for the absorption-bands in the spectrum of the light transmitted by a thin layer of the fine powder, strongly illuminated from the other side, are as distinct as in that transmitted by a many times greater thickness of solid and transparent crystal. We may very conveniently take advantage of this fact in studying the spectra of such substances when the amount of material at command is otherwise too small. This seems to be because the transmitted light does not simply pass through the crystals, but is in great measure reflected from them backwards and forwards, and thus, as it were, passes through a greater thickness. It is also to a considerable extent similar to that reflected from the powder when illuminated from above, as may be clearly proved by what occurs in the case of uranic salts. These, when in a state of moderately fine powder, transmit light giving a spectrum showing not only the absorption-bands in the blue, which alone are met with in that transmitted by a clear crystal, but also those in the green, which depend on fluorescence, characteristic of that reflected from the powder.* These two kinds of bands can be easily distinguished by means of a plate of deep-blue cobalt glass, which has an entirely different action according as it is placed below or above the object, when the bands are due to fluorescence, but has no such effect when they are due to ordinary absorption. It would, perhaps, be well to mention here that I have in this manner proved that the abnormal bands seen in the spectra of the compounds of zirconia with the oxides of uranium, described in this paper, are due to genuine absorption, and not to fluorescence.

The remarkable spectrum of some jargons has been already described by me in the Chemical News (vol. xix. p. 122; *Am. Repr. May '69. page* 233), and in the *Proceedings of the Royal Society* (vol. xvii., p. 511). One of its most striking peculiarities is that, when light passes in a direction perpendicular to the principal axis of the crystal, and the spectrum is divided by means of a double-image prism into two spectra, having the light polarised in opposite planes, though some of the absorption-bands are of equal intensity in both images, yet others are comparatively absent, some in one and some in the other; whereas, in the case of other dichroic crystals which give spectra with absorption-bands, they are usually all more distinct in one image than when the light is not polarised, and all fainter, or even comparatively absent, in the other. No sooner had I observed this spectrum than I made various experiments in order to ascertain whether uranium was present or not; and the then known tests that could be applied to the amount of material at my command seemed to show that it was absent. This was quite in accord with the results of the various analyses published by other chemists, none of whom mention the existence of any trace of that substance. Moreover, the general character of the spectrum was entirely unlike that of all the known compounds of uranic oxide. The various artificial salts all agree in giving a variable but small number of moderately broad absorption-bands in the blue end; and the same is also seen in the case of several natural minerals; whereas the jargon gave a most unusually large number of narrow black lines (fourteen quite distinct, besides others more faint and a single broader band which I cannot separate into lines), extending from the red end; so that nearly all occur in that part of the spectrum which is entirely free from bands in all previously-known compounds of uranic oxide. This same general fact was also seen in the spectrum of the opaque blowpipe beads gently flamed, as described in my former paper.

I will not now enter into a description of the various chemical and physical facts which seemed to warrant the conclusion that zircons sometimes contain a new earth; but, taking these into consideration, there seemed to be every reason to believe that spectra which thus differed so much from those of any previously-known substance were characteristic of this new earth. Judging from the facts then known, it was more probable that spectra of such a new type were due to a new element than that they were due merely to a combination of two such elements as zirconium and uranium. Some of these chemical and physical facts can now be explained by the presence of uranium; but, besides this and several of the more common earths and oxides, I have detected, in some zircons, erbium, didymium, yttria, and another substance, which exists in such small quantity that I have not yet been able to ascertain whether or no it is the suspected new earth. These accidental constituents do not, indeed, occur in sufficient quantity to be of importance, except as modifying the physical and optical properties, the didymium giving usual characteristic absorption-bands (zircons from Svenerое, Norway), and the manganese the same spectrum as that of garnets (zircons from an unknown locality in Siberia).* This method, however, fails to give evidence of a new earth; for, since the publication of my former paper, I have proved that the very abnormal spectra, which seemed sufficient to establish its existence, are really due to compounds of zirconia with the oxides of uranium, which have such a powerful action on light that an almost inappreciable amount is sufficient to produce the spectra to great perfection—in fact, so small an amount that the total quantity which misled me was only a few thousandths of a grain; and its presence might easily have remained unsuspected if I had not made a number of experiments which, at first, did not seem to have much connection with the subject.

In studying the spectra of crystalline blowpipe beads, it seemed desirable to examine those made with carbonate of soda, with or without a little borax. This, when melted, dissolves certain oxides; and, though it crystallises on cooling, so as to be only partially translucent, yet, with strong direct sunlight, well-marked spectra may be seen. For example, in the oxidising flame, uranic oxide is easily dissolved by carbonate of soda alone, and, when quickly cooled, an orange-coloured bead is obtained, probably containing uranate of soda in a vitreous condition, which gives a single

* See Stokes's papers. *Phil. Trans.*, 1852, p. 463, and 1853, p. 392.

* For both of these I am indebted to my kind friend Mr. David Forbes.

well-marked absorption band in the green with so small a quantity of the oxide that, in a bead ¼ inch in diameter, 1-2000th grain shows the spectrum to the best advantage, and even 1-10,000th grain can be easily detected. We need not be surprised that this spectrum differs so much from the usual type of uranic salts, since, in this case, the oxide plays the part of an acid. It may be only an accidental coincidence, but this difference is analogous to what so commonly occurs on adding an alkali to neutral solutions of vegetable colours.* When gently re-heated, it seems as if the uranate passed into a crystalline state, for the spectrum then shows four absorption-bands, and is more like the ordinary type; but this change does not occur if a little borax had been added. The addition of more and more borax causes the absorption-band to become more and more faint, and to advance towards the blue end, until we obtain a spectrum with very faint bands, but of the usual character.

In examining the various products into which I separated jargons in order to study the supposed new earth in a state of purity, I obtained a small quantity of a dark-coloured substance (apparently zirconia) containing some oxide, which communicated a green tint to a glassy borax blowpipe bead, but yet not sufficiently distinct to show that it was due to uranous oxide. I therefore thought that the carbonate of soda method might throw light on the question; and, though the presence of zirconia prevented solution by pure carbonate of soda, the addition of a little borax enabled me to prove that uranic oxide is really present in some jargons. Such, then, being the case, it seemed desirable to ascertain whether the oxides of uranium would give rise to any special spectra when present along with zirconia in crystalline blowpipe beads. To my astonishment, I found that the spectra were precisely the same as those obtained in the case of what I had thought to be an approximately-pure new earth. When, however, I had ascertained the quantity of oxide requisite to give this result, I was no longer surprised that I had not suspected its presence. In the case of transparent blowpipe beads of borax with microcosmic salt, it is requisite to have as much as about 1-50th grain of uranous oxide to show faintly the characteristic absorption-bands; whereas, when present along with zirconia in the crystalline beads, 1-50,000th grain gives an equally well-marked spectrum; and 1-2000th grain shows it far better than a larger quantity, which makes the beads too opaque. These very minute quantities were obtained by the repeated division of a small known weight, either before or after fusion with borax. This spectrum also differs very considerably from the spectra of the usual salts or blowpipe beads of uranous oxide. On comparing them side by side, the only common peculiarity is the fact of there being numerous absorption-bands distributed over a large part of the spectrum, but they do not correspond in either number or position; on the contrary, they differ almost as much as possible; and the darker bands in the spectrum of this zirconia compound occur where the transmitted light is the brightest, in other cases.

The oxide of uranium is so easily reduced at a high temperature to the state of protoxide in a borax bead with excess of boric acid, and is so readily peroxidised at a dull red-heat when crystallised along with borate of zirconia, that there seemed good reason to refer the change in the spectra to temperature rather than to the state of oxidisation, until after it was found that they were due to uranium. By gently flaming the crystalline bead, the spectrum is entirely altered to that which seems to be characteristic of the compound of borate of zirconia with uranic oxide. This shows a spectrum with five well-marked absorption-bands, all of which occur at the red end, where there is no trace of bands in the case of the ordinary compounds of uranic oxide. I have tried many experiments in order to ascertain whether any other element besides zirconia will cause uranium to give similar abnormal spectra; but none show anything of the kind—at all events in similar conditions. A few have special characters, as described below; but the majority exert little or no influence; and, even when the blowpipe beads are crystalline, they show only the usual spectra of the oxides of uranium. Moreover, no such great change in the character of the spectra of any other elements which give absorption-bands is to be seen when they are combined with zirconia; and, as far as my present experience goes, it seems as if such very abnormal spectra were met with only in the case of these remarkable compounds of zirconia with the oxides of uranium.

Such, then, being the facts, it appears to me that we are now in a position to explain why certain zircons give three different spectra, as described in my former paper. Some jargons (usually those of a green tint) contain a little uranium so combined that the characteristic spectrum is only faintly visible; whereas, after ignition, the intensity of the absorption-bands is permanently increased to a variable extent, occasionally only a little, but, in some cases, as much as twenty-five times. This more powerful action on light is accompanied by an increase in hardness and in specific gravity (sometimes as much as from 4·20 to 4·60), as described in my former paper; and I have since found that these changes are approximately proportional to the amount of uranic oxide in the various specimens, as shown by comparing the spectra of the blowpipe beads. This change may partly depend on the oxidisation of the uranous oxide, since some specimens slightly increase in weight when ignited; but I think it cannot be mainly due to that, for sometimes there is no such increase; and uranous oxide, combined with zirconia, gives rise, not to a spectrum without bands, but to one with several of very marked character, as described below. On the whole, since this abnormal type of spectrum is so characteristic of combination with zirconia, it appears to me more probable that the effect of a high temperature is to cause the uranic oxide to combine more specially with the zirconia, as though the greater part existed naturally as a silicate, but after ignition as a zirconiate. We may also apply the same explanation in the case of zircons more or less strongly coloured by other oxides, which become almost colourless when heated; and thus this unexplained peculiarity of zircons may depend on the fact of zirconia being able to play the part of both a base and an acid, which, as compared with silica, has an affinity for bases varying according to the temperature.

The brown-red zircon from Ceylon (named at page 514 of my former paper, kindly presented to me by Mr. E. L. Mitford, of Rusthall) gives a spectrum precisely like that of the borax blowpipe beads crystallised after treatment in the deoxidising flame, and, therefore, no doubt contains uranous oxide. This spectrum, being given by only one part of the crystal, probably depended upon the presence of some substance which either reduced the uranic oxide or prevented the oxidisation of the uranous.

* See my paper in *Proc. Roy. Soc.* 1867, vol. xv., p. 433.

These facts thus clearly show that the various spectra which seemed to indicate the presence of a new element existing in three different physical conditions are, in reality, only characteristic of the two oxides of uranium, combined with zirconia or not in combination. Perhaps some may think that my having been thus led astray shows that little or no reliance can be placed on the method of investigation employed; but I contend that the mistake was due to its being such an unexpectedly delicate test for uranium; and, as explained above, the error was ultimately corrected by a further development of the same method. As far as the interests of science are concerned, there is no need to regret the general result. We have lost what appeared to be good evidence of a new earth, but have gained an almost entirely new system of blowpipe testing, which enables us to detect such a minute quantity of some substances as could not be recognised by the ordinary means. I shall not now attempt to give anything like a full account of this subject, since it would be much better to let it form part of a paper on various improvements in blowpipe chemistry, but will merely mention a few facts which have a special bearing on the question before us.

In the first place, I would say that zirconia and the oxides of uranium are most useful reagents in detecting the presence of certain substances, with which they unite to form compounds having very special characters. The most striking of these are the compounds already described, which are distinguished by the spectra, and not by any well-marked colour—the compound of ceric oxide with uranic oxide, which is of a splendid deep blue colour, but shows no absorption-bands; and that of yttria with uranic oxide, which is characterised by a deep orange-colour and extreme fusibility. Thorina and oxide of lanthanum form with uranous oxide compounds which give spectra with absorption-bands in special positions, but of the usual type, and not of such a marked character as to be useful in detecting minute quantities of those substances in mixtures.

In order to see the spectra of the zirconium-uranium compounds, it is requisite that their oxides should be combined in a crystalline condition. When both constituents are melted in borax and are held in solution, or if, when crystals are deposited, any other substance replaces either the zirconia or the oxides of uranium, the characteristic spectra cannot be seen. The most simple application of this test for uranium is in the case of various zircons. As much of the powdered mineral as will dissolve should be melted with borax in a circular loop of platinum wire about ⅛ inch in diameter, so as to give a bead of moderate thickness. A little boric acid should then be added, which not only tends to keep the uranium in the state of protoxide, but also facilitates the crystallisation of the borate of zirconia, which is far less soluble when there is excess of boric acid. The bead should then be kept at a bright red heat, just within the deoxidizing flame, until so much borax has been volatilized that small needle-shaped crystals begin to be deposited, when it must be allowed to cool rapidly. It should then be transparent with scattered crystals, and the uranium all in the state of protoxide. On gently re-heating it, the bead ought to suddenly turn white and almost opaque; and care must be taken not to heat it any more than is just requisite to cause the borate to crystallise out, or else the uranium will rapidly pass into the state of peroxide. Such beads must be examined by strong direct light from the sun, or from a lamp of very great brilliancy, condensed on them by means of an almost hemispherical lens of about ½ inch focal length; and in addition to the means described in my former paper, I have since found it very convenient to place them over a hole in a black card, so as to entirely prevent the passage of any light which has not penetrated through them, even when so arranged in the focus of the microscope that the spectrum of their thin edges may be examined, if the centre be too thick and opaque. If thus properly prepared, the presence of more or less uranium will be shown by the greater or less intensity of the absorption-bands of the spectrum described and shown in Fig. 1 of my former paper. This test is so delicate that there is no difficulty in seeing the darker band in the green in the case of zircons which contain no more than 1-10th per cent of uranic oxide; and I find that very few localities yield this mineral so free from it that it cannot be easily detected. Those from Miask, Siberia, are the only specimens in which I have not been able to recognize it. The jargons from Ceylon contain an amount varying up to about 1 per cent, although in no published analysis that I have seen is there any allusion to the presence of even a trace. It has also been overlooked in several other cases; and it now becomes important, because it gives rise to various well-defined spectra, which are so characteristic of the different minerals, that they can be very conveniently identified, even when cut and mounted as jewels, by means of the number and position of the absorption-bands, as I intend to explain in a paper on the spectra of minerals.

In applying this test to detect minute quantities of uranium in other minerals, it is requisite to bear in mind that zirconia may play the part of both an acid and a base, and that various oxides and acids so combine with the zirconia or the oxides of uranium as to prevent the formation of the compounds which give rise to the characteristic spectra. The zirconia appears to combine with some rather than with the uraneous oxide, and with others rather than with the uranic, so that, if one spectrum cannot be obtained, the other may; and there are few, if any, cases when neither can be seen, especially if care be taken to use excess of zirconia. If, however, the amount of uranium be very small, and so much of other oxides be present as to make the bead very dark, or too opaque from deposited crystals, before it is sufficiently concentrated for the compounds with the oxides of uranium to crystallise out, it may be impossible to detect it. In order to apply the test in the case of complex minerals, a bead of borax, boric acid, and pure zirconia should be prepared, then a small quantity of the mineral added, and, after fusion and sufficient concentration, the bead made to crystallise in the manner already described. If needle-shaped crystals be not deposited in the bead when very hot, and if it do not suddenly turn opaque when re-heated, the result may not be satisfactory. In this manner it is easy to detect uranium in 1-200th grain of such minerals as Fergusonite, tyrite, and yttrotantalite, even when they contain no more than 1 or 2 per cent If, in such cases, the spectrum of the uranous compound cannot be obtained, the bead should always be flamed and re-examined, to see if that of the uranic compound is thereby developed.

In a similar manner, we may make use of a little oxide of uranium to detect zirconia; but the test is far less delicate than the converse, because it is almost impossible to obtain the compound in a crystalline state,

unless there be an excess of zirconia. Not more than 1-1000th grain of uranic oxide should be employed, or the bead may be too opaque. There is no difficulty in thus detecting zirconia in zircons, or in katapleiit; but the presence of so much of other bases in minerals like eudialyte prevents our obtaining a satisfactory result. There certainly could not be a more characteristic test to confirm the results of other methods, or to identify such a small quantity of approximately pure zirconia as could not easily be distinguished in any other way.

The only other compound of uranic oxide of very abnormal character which I have so far discovered is that with ceric oxide. So much of both should be fused with borax in the oxidising flame as will yield a bead which is perfectly clear and of pale yellow colour when rapidly cooled, but crystallises when gently reheated. If the constituents be present in a certain proportion, it then turns from pale yellow to a deep blue, as though coloured by oxide of cobalt. In most cases, the bead is rendered nearly opaque by the number of crystals; but sometimes, though it turns deep blue, it remains transparent, owing to the compound being set free in a state similar to that of the red oxide of copper in a borax blowpipe bead, with carbonate of soda and oxide of tin, treated in the reducing flame. The spectrum of these blue beads shows no absorption-bands, but merely a general absorption at the red end; and it is curious to find that the combination of two yellow substances give rise to a deep blue, in much the same manner as when the yellow ferrocyanide of potassium is added to a yellow ferric salt. The production of this blue colour, on the addition of a little uranic oxide, might be employed with advantage to identify moderately small quantities of cerium, even when mixed with a number of other substances; but, unfortunately, the presence of much oxide of lanthanum, which is so commonly associated with it, interferes, as though the ceric oxide had a stronger affinity for the oxide of lanthanum than for uranic oxide.

The most characteristic peculiarity of the compound of yttria and uranic oxide is that it will not crystallise out from a borax blowpipe bead, and that the affinity of the uranic oxide for yttria is stronger than for zirconia. Perhaps erbia may prove to act in the same way, but I have not been able to examine that earth quite free from yttria. On adding yttria to a bead with zirconia and a little uranic oxide, and gently flaming it in the oxidising flame, the uranic oxide combines with the yttria and rises to the surface as an orange-coloured scum, which has a great tendency to collect on the platinum wire; and, if sufficient yttria was added, the crystallised borate of zirconia is left in the interior almost colourless, and so free from uranic oxide that no absorption-bands can be seen in the spectrum. We may take advantage of this circumstance to detect yttria in small quantities of compound minerals like Gadolinite and Fergusonite; and I may here say that, by combining such means with the observation of the spectra of the transparent, or crystalline beads, and of the form of the crystals when slowly deposited, with or without the addition of suitable reagents,* we may often detect twice as many constituents in minerals as could be accomplished by the ordinary methods of blowpipe chemistry—an advantage which I am sure will be appreciated by those engaged in the study of rocks, when it is often so important to obtain satisfactory results with small quantities of material. I have also found these methods of great practical use in examining small residues in the qualitative analysis of minerals, and have thus unexpectedly discovered small quantities of comparatively rare elements.

I have tried the effect of many other substances along with zirconia and the oxides of uranium, and find that most of them have no sensible influence, unless they are present in considerable relative quantity. The most striking effect is that of oxide of tin, which causes the two absorption-bands in the yellow and yellow end of the green in the spectrum of the uranous oxide compound to be nearly equally dark; whereas, without the oxide of tin, that in the yellow is comparatively faint. This is another illustration of the manner in which certain substances having no special action on light influence by their presence the properties of another. The oxides of uranium are unusually sensitive to such actions, and thus not only lend themselves to us as blowpipe reagents, but also seem more than any others to afford the means of explaining the relation between the physical conditions of compounds and their action on light.

The only compound of zirconia with any other oxide to which I need now draw attention is that with chromic oxide, as deposited from a borax blowpipe bead. When treated in the deoxidising flame, and when cold, the very pale green bead gently re-heated, this compound crystallises out so as to give a fine red-pink colour by transmitted light, even when so little chromium is present that the glassy bead is scarcely at all green. If too strongly heated, the pink tint is lost. This compound is of interest in connection with the colour of rubies and other minerals coloured red by chromic oxide. To others, like the emerald, it communicates a green colour, and, on the whole, it acts on light in such a variable manner, according to the presence of other substances, that the spectra may be made use of as a means of identifying particular minerals, though they do not present anything like such striking anomalies as those met with in the compounds of zirconia with the oxides of uranium.

* See my paper, *Monthly Microscopical Journal*, vol. i., p. 349.

[English Edition Vol. XXI, No. 534, pages 75, 76.]

ON CHLORAL HYDRATE.

BY DR. MACVICAR, MOFFAT, N.B.

The physiological interest which attaches to this substance at the present moment induces me to present it as it presents itself in the system of molecular morphology, since I find that this may be done (though, of course, not very well) by the use of such types as are already in the hands of the printer as representatives of the forms of the elements involved.

As to the laws of chemical union and decomposition which are here referred to, or, indeed, which are ever admitted in the molecular nature which I advocate, they are all included in the law of symmetry, culminating in sphericity, towards which the first step usually is the union of dissimilars, when they come into the same neighbourhood.

It is only necessary to add (since no printer's type in use can show it) that the atom of hydrogen is the simplest structure possible into which equal and similar elements of matter or force can be built up so that it shall be truly symmetrical in relation to the sphere—that is, shall have two poles which are similar to each other, and an equator lying evenly between them. It, therefore, consists of five material units—two for the two poles, and three for the equator (for no smaller

number than three can determine a plane). As to its form (that is, the form of the nucleus, for, as to the ethereal atmospheres of all atoms, they are universally spheroidal or spherical), supposing it viewed in reference to the lines of resultant force which join the five constituent forces in the angles, and so give edges to the form, we may say that it is doubly trachar or lance-shaped. The limit of its atomicity is 5. It may possibly carry atoms of some other substance, single or multiple, piled one on each of its two poles and three on its equator, five in all, but no more.

Its symbol, as a chemical agent, may be represented by three dots in a horizontal line, to represent its equatorial atomicity, as, also, other two, one above and another below, to represent its polar atomicity.

Hydrogen: its atomicity = 5.

But, for convenience, we may take to stand for it merely a printer's dash or dagger, the former of which may represent unity, also its atomic weight on the usual scale.

Hydrogen: its usual symbol.

For oxygen, we may take the figure 8, laid horizontally, and with an uniformly-broad face. Since the atom of oxygen comes out in shape a double concave lens, like a blood-disc or life-buoy, the cypher that has been named has some resemblance to its vertical section through the centre. It is also the atomic weight of a single atom on the usual scale, the law of sphericity requiring that these atoms, when in the free state, shall go in couples,

Oxygen gas.

the atomic weight of each 16 when H = 1.

$= HO$

Moisture.

The atom of carbon comes out a doubly-convex lens, fitting that of oxygen, as in an achromatic arrangement of lenses; it may, therefore, be represented by a narrow letter O. As in the case of oxygen, and for the same reason, single atoms of carbon tend, also, to go in couples; but it is not possible to use the atomic weight

A coupled atom of carbon.

6 or 12 as its symbol in diagram-formulæ.

Add to these a longer letter of the same kind, to represent chlorine, and we have symbols sufficient for our present purpose.

Chlorine.

Carbon is first given to nature as the hydrocarbon, $HCH = CH_2$, a lengthened form of which every two

Nascent marsh gas.

under the law of sphericity unite in couples, constructing thereby a most exquisitely-spherical and finely-differentiated structure, viz., $\overset{4}{C}HC = C_2H_4$ = marsh gas.

Mature marsh gas.

The genetic atomicity of a coupled atom of carbon is, therefore, 4, in reference to hydrogen; and marsh gas is the perfect hydrocarbon. It is indestructible, if the temperature of its genesis be respected, and is most fit for existing in the aëriform state above.

But nature detains it below, by loading, during vegetation, each of the three hydrogen-arms of the equator with an atom of carbon. And this may be applied to the axial atom in so many different ways that the formula $CH(HC)_3C = C_8H_4$ will represent many substances of different properties. Of this element, the smallest

The essential-oil element.

dense molecule must be the tetratom, giving, as its formula, $4 \times (C_8H_4) = C_{20}H_{16}$, which is the chemical formula of non-oxygenated essential oils.

In regions of vegetable nature, where free carbon prevails still more, the retained hydrogen is made to go still farther, and one essential-oil element is made to yield four alkaloid elements—that is, elements in which each single atom of hydrogen is an axis loaded with five of carbon, thus saturating its atomicity.

The alkaloid element.

Unhappily, the load of carbon here is so great that this structure cannot be raised, by the chemist, into the aëriform state and sublimed. It appears to him merely in a carbonaceous residuum containing hydrogen.

But when one atom of hydrogen more is added to either pole, the atoms can ascend in couples and be sublimed, their first dense molecules being the tetratom, giving $4 \times (C_8H_2) = C_{20}H_8$, which is the usual formula of naphthaline. Respecting this substance it is impossible to say to what valuable account the ingenious chemist may yet turn it for enhancing the enjoyment of life and for the relief of suffering.

The naphthaline element.

Returning now to marsh gas, with which we set out, it is to be considered that it may be loaded with carbon on the poles, as well as on the equator. Thus, in dry and hot regions, there may be on each pole a coupled, instead of a single atom of carbon, giving $C_2H_4C_2 = C_4H_4$ = olefiant gas.

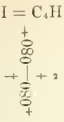
Olefiant gas.

And in moist and cool regions, there may be an atom of simple hydrate of carbon, CHO—that which we obtain from the breaking up of an atom of sugar, $C_{12}H_{12}O_{12}$—and which we may call the saccharine element, which is trimorphous.

The saccharine element.

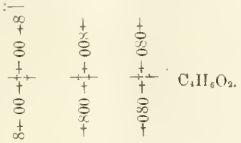
Place one of these saccharine elements—say that in the middle diagram—upon the poles of one atom of marsh gas and we obtain—

$$HCOCHCOCH = C_4H_6O_2 = \text{Alcohol.}$$



Alcohol.

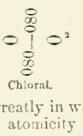
Its three forms may be represented in our figurate formulæ. The chemical formula of all the three is, of course, the same :—

Alcohol  $C_4H_6O_2$.

And this, we see, must be a very quick substance, its poles being capable of any one or other of these different structures, according to the conditions of its existence.

Under the law of sphericity, its axis is, however, too long; it is ready to lose something from its poles, and to receive expansion of its equator. Let chlorine, then, be let in upon it, so as not to disorganise it, but to improve its form, and we may expect that two atoms of the halogen will carry off the two atoms of hydrogen from the poles, as hydrochloric acid, thus shortening the axis, which was the first thing required by the law of symmetry (sphericity), and, afterwards carry off the three atoms of hydrogen now constituting the too feeble equatorial region, and leave three of chlorine in their stead. The atom of alcohol will thus be transformed into—

$$COCHCl_2COC = C_4HCl_3O_2 = \text{chloral.}$$



Chloral.

But this structure is greatly in want both of hydrogen and of oxygen; for the atomicity of a single atom of carbon is 2, in reference to oxygen, as well as hydrogen; and here there are only 2 of oxygen and 1 of hydrogen for 4 of carbon. Since, then, the law of symmetry allows it, we may expect that, on access being granted to moisture, the terminal atoms of carbon on the poles will resume their original condition of saccharines, and we shall have—

$$HO\ OCHCl_2COCOH = C_4H_3Cl_3O_4 = \text{chloral hydrate.}$$

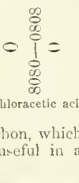
Chloral hydrate.

Now, as the poles (the region of chemical activity) here are saccharines, as in alcohol, there seems no reason to apprehend that this substance, so long as it keeps together in the living body, will be more poisonous than alcohol, though it must be more powerful. As to where it will break up when it is obliged to do so, this will depend on the process by which it was made (for every substance, when decomposing, other things being equal, tends to reproduce its original constituents) and on its surroundings. But, viewed in reference to its own structure, it may be regarded as an atom of chloroform, C_2HCl_3, capped on both poles by fully-oxidised saccharines—that is, by the formic element, CHO_2, the couple of which gives $C_2H_2O_4$, or $C_2HO_3.HO$ = formic acid.

Chloroform.

The formic element.

When chloral hydrate then meets with matter more powerfully alkaline than its own body (which is an atom of chloroform), the polar elements may be expected to go off, thus exposing an atom of chloroform. Suppose they were to go off as saccharines, they would do no harm, nor would the dioxide of chloroform that remained probably be so dangerous, or effective, in causing sleep ("the sister of death") as the chloroform itself. But formic acid, if by any mistake it should get free, might prove a very disorganising agent. But would not all danger from the breaking up of the polar matter be avoided, if, for chloral hydrate, trichloracetic acid could be substituted, for then there would be given



Trichloracetic acid.

off only dioxide of carbon, which is perfectly harmless and might even be useful in assisting the hypnotic action.

REPORTS OF SOCIETIES.

CHEMICAL SOCIETY.

February 3rd, 1870.

Dr. A. W. Williamson, F.R.S., &c., *President, in the Chair.*

Mr. Chapman read "*A Note on the Organic Matter Contained in the Air.*"

Some time ago, the author, in connection with Mr. Wanklyn and Mr. Smith, found that the smallest traces of nitrogenous organic matter in water could be detected by converting the nitrogen of the organic matter into ammonia, and then trying with Nessler's test. It occurred to the experimenters that the process might be extended to the investigation of the air, by washing it with water, and examining the water; but Mr. Chapman found the operation of washing the air more difficult than he had expected. It seemed the most obvious method to draw air through water, or through some other medium which would have afterwards to be washed with water. The absorption by water alone proved insufficient. Filters of cotton-wool and gun-cotton acted very well; but neither of the two materials could be obtained free from

traces of nitrogenous substances. Asbestos seemed to be sufficiently good; but the preparatory treatment it has to undergo before its use in the experiment is too troublesome. Lastly, finely-powdered pumice-stone was tried as a filtering medium, and was found satisfactory in all respects. It has to be heated to redness before it is employed, and is then moistened with some water, spread over coarser pieces of pumice, which rest on some wire-gauze fitted into a funnel. When a sufficient quantity of air (say 100 litres) has been drawn through the apparatus, the pumice is transferred to a retort which contains water freed from ammonia and organic matters; and the operation is now proceeded with exactly as if it were an estimation of nitrogenous organic matter in a sample of water.

By this method, Mr. Chapman found that the air of crowded rooms contains suspended nitrogenous organic matter, as well as volatile organic bases. The first can be removed by filtration through cotton-wool; the latter pass through the filter, and, when conducted into water, can be detected there. Air collected from the neighbourhood of a sewer contained notable quantities of these volatile bases. The author thinks it would be of interest to investigate, by the above-described method, the air in hospitals, fever wards, and the like places.

With respect to the examination of the volatile bases occurring in the air—

Dr. Mills suggested that the charcoal out of the Stenhouse air-filter might furnish a good means for collecting those bases.

In another paper, Mr. Chapman communicated "*Some New Reactions of Alcohols.*"

Amylic alcohol, as commonly obtained, consists of two liquids, one rotating a ray of polarised light, the other not. The two may be separated by distilling the mixture from soda, calcic chloride &c. The non-rotating alcohol is retained; the rotating distils over. But, by repeated distillations, it was found that the rotating alcohol is converted into the non-rotating by the very treatment employed to separate the two. No difference in the physical properties of the two alcohols is perceptible. The compounds of the non-rotating liquid do not turn the ray of polarised light; those of the rotating do, and that in an opposite direction to the original alcohol. These facts seem to indicate that the internal structure of organic compounds is not so permanent as we are in the habit of thinking. Another observation Mr. Chapman made whilst pursuing these experiments was that caustic soda is not merely unable to dry alcohol, but that it actually hydrates it. On proper investigation, it turned out that the sodium replaces the hydrogen of the alcohol, whilst the displaced hydrogen takes the place of the sodium in the caustic soda, and thus produces water.

The President, referring to this latter observation, remarked that it confirmed the idea of a double decomposition taking place when a potassic hydrate is dissolved in alcohol—an idea derived from the well-known reaction of carbonic acid on a solution of potassic hydrate in alcohol, whereby ethylo-potassic carbonate, as well as potassic carbonate is formed.

Mr Perkin exhibited a modification of Berthelot's method for the synthesis of hydric cyanide by direct union of acetylene and nitrogen under the influence of the electric spark. Mr. Perkin takes advantage of the fact that nearly all the hydrocarbons yield, when submitted in the state of vapour to the action of the spark, more or less acetylene. Nitrogen was caused to bubble through benzole; then to pass through a globe, in which the spark was discharged; and thence into a solution of silver. After a few seconds, abundant evidence of the formation of hydric cyanide was obtained. Hydric cyanide was also produced when the spark was discharged through a mixture of ammonia gas and ether vapour. If, however, nitrogen, instead of ammonia, is employed, no cyanide is produced, notwithstanding that acetylene is formed from the ether. Mr. Perkin's modification of Berthelot's method is well adapted for purposes of lecture-demonstration.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, January 11, 1870.

E. P. Joule LL.D., F.R.S, *President, in the Chair.*

"*On the so-called Molecular Movements of Microscopic Particles,*" by Professor W. Stanley Jevons, M.A.

Robert Brown, the celebrated botanist, first pointed out, in the year 1827, that minute particles of unorganised matter suspended in water exhibit movements which may easily be mistaken, and were formerly mistaken, for the movements of living animalculæ. This motion is exhibited more or less by all substances which are reduced to a sufficiently fine state of division (1-5000th inch in linear magnitude to 1-50000th), and the phenomenon is familiar to all occupied in microscopic observation. Vague suggestions have been often put forth that the motion is due to heat, to electricity, or to chemical affinity, but I have been able to find few published experiments on the subject, and those not of a conclusive kind.

In investigating this phenomenon, I did not learn much by varying the solid suspended substance. The silicates, indeed, appeared to be generally the most active substances, and the purest quartz crystal when reduced to fine powder oscillated rapidly; but such different substances as charcoal, red phosphorus, antimony, and sulphur were also very active. I cannot affirm that any substance is free from movement, but the metallic oxides, and the earthy salts, such as carbonate of lime, appeared to me somewhat less active in comparison.

In varying the liquid, however, by dissolving different salts therein, I was soon struck by the fact that the purest distilled water alone gave the movement in the highest perfection. With a few exceptions, soon to be noticed, all acids, alkalies, or salts tended to diminish the movement in a manner wholly independent to their peculiar chemical qualities.

The inquiry was much facilitated by discovering that the microscopic movement is closely connected with the suspension of fine powder in water.* Clay and pounded glass which are most active in the microscope are also capable of remaining long in suspension. All acids, alkalies, or salts which checked the motion under the microscope were found also to have a power which has not been sufficiently noticed, of precipitating suspended matter. At the same time gum arabic, which possesses a most extraordinary power of exciting the molecular movement, is also capable of maintaining powder in suspension, and has long been used for this purpose in the manufacture of ink. The molecular motion does not directly affect the gravity of the particles, but it prevents the particles from aggregating together into larger bodies and thus overcoming the resistance of the liquid.

That the motion is due to electricity I was soon convinced, by the close analogy with the circumstances in which electricity is produced by the hydro-electric machine. Armstrong and Faraday found that pure water in this machine alone produced much electricity, and that almost any salt, acid, or alkali prevented the action by rendering the water a conductor. Ammonia, however, is a remarkable exception, because it does not render water a good conductor, and does not prevent the hydro-electric machine from giving off electricity. In trying ammonia as an *experimentum crucis*, I found that it did not stop the microscopic movement, and had almost an inappreciable effect in precipitating suspended matter. A solution of 10 per cent of ammonia would have less effect than 1-100th per cent of sulphuric acid The proof is rendered practically certain by the fact that boracic acid, which was also ascertained to be a non-

* I have since found that the microscopist Dujardin noticed this connection. See "*Manuel Complet de l'Observateur au Microscope.*" Paris, 1843, p. 60.

conductor by Faraday, does not precipitate matter from suspension.

It is right to add, however, that in the case of acetic acid there is a discrepancy; Faraday stated that it does not render water a conductor; but I find that, in common with the other vegetable acids which I have tried, it occasions precipitation. The conducting qualities of the substance have not been determined with sufficient accuracy to render a mistake impossible.

It is probable that silicic acid does not render water a conductor, as I find that silicate of soda tends to increase rather than diminish microscopic movement, and is another remarkable exception to the general precipitating power of soluble substances.

I entertain no doubt that microscopic movement is closely connected with the phenomena of osmose so fully investigated by the late Mr. Graham. The connection is that of action and reaction; for if a liquid is capable of impelling a particle in a given direction, the particle, if fixed, is capable of impelling the liquid in an opposite direction by an equal force. The earthenware jars used by Graham in many of his experiments are composed of a substance highly active under the microscope, and the fact that osmose is most shown by very dilute solutions (1 per cent or less) is entirely in accordance with the electric origin of the phenomenon.

I consider it to be established experimentally that the microscopic movement is due to electric action, and if I may venture to suggest a somewhat speculative explanation of the action I would point to the experiments of M. Wiedemann on electric osmose. It was first observed by Mr. Porret that when the poles of a battery are placed in two portions of water separated by a porous division, not only is some of the water decomposed, but another and far larger portion is impelled towards the negative pole. M. Wiedemann, having exactly investigated the phenomenon, found that, for one part of water decomposed, 5 000 parts were transported through the porous septum. This impulsion is greater as the resistance of the liquid is greater, and ceases altogether when sufficient acid or salt is added to render it a good conductor. Every particle which is thrown into a polar condition by the action of water must be capable in a minute degree of exerting a similar force. In ordinary osmose the particles being fixed cause a transportation of the fluid; in microscopic movement, on the other hand, the particle is free to move, and the reaction of the liquid probably produces those movements which are visible in the microscope.

Although I have chiefly confined my attention to inorganic substances, I have also found that all organic solid particles which are sufficiently small exhibit the movements in a high degree. Albumen, dextrin, grape or cane sugar, starch solution, alcohol, &c., seem to have little or no power of destroying the motion, and the extraordinary properties of gum arabic have been noticed. I think it not unlikely that when these phenomena are fully investigated they will give strong support to a theory lately put forward by M. Becquerel, that the movements of fluids in animals and plants, which have often been attributed by Graham and others to osmose, are really due to minute electric currents.

Mr. Dancer, F.R.A.S., stated, that the subject which Professor Jevons brought before the meeting, was one to which he had paid attention at intervals for the last thirty years. He had repeated Dr. Robert Brown's experiments with the majority of the substances named in his paper, and had also experimented with a great number of other substances and different solutions.

The particles approaching a spherical form gave evidence of the greatest activity, with some few exceptions. The activity and duration of the movements vary according to their magnitude and also the solution in which they are suspended. For instance, some of the metallic oxides would exhibit the movement for some time, and then gradually get aground on the glass plate, and cease to move. There was some difficulty in reducing metals to particles sufficiently small and regular in form for the exhibition of the molecular movement; even hardened steel, when rubbed on a very fine hone, appears fibrous, and soft metals, such as platinum and copper, like shavings, under a high magnifying power. Those siliceous particles of the hone which have their lines of cleavage favourably situated are frequently detached in thin plates during the act of grinding, and form brilliant objects when viewed by polarised light. Metals reduced in this manner require re-grinding several times before they lose their fibrous character, and become sufficiently minute for successful experiments.

Metallic oxides vary considerably in their form and magnitude, according to the solutions from which they are precipitated. By practice it would be possible, in many cases, by their microscopical appearance, to name the solutions from which they had been precipitated. The activity of these, when of favourable size, say from the 1-30000th to 1-50000th of an inch, is very different, being great in water, solution of gum, sugar, &c., but quite inactive in oil.

Mercury and sulphur when sublimed assume a spherical form, and although these spheres could be obtained from 1-1000th to 1-50000th of an inch in diameter, they do not exhibit any movement in water. He has sublimed them on to a drop of water, but they refused to sink. Possibly their polished surfaces retained a film of air which floated them. So transparent and perfect in form are the sulphur spheres that they distinctly exhibited the image of a lamp flame at their focal point. Triturated or precipitated sulphur will exhibit active movement in various solutions. As regards the cause of this so-called molecular movement, Mr. Dancer thinks that chemical action will not account for it. Diamond dust, graphite, and other refractory substances, are found to be active in water and solutions of gum. Nor is electricity a satisfactory explanation to him. He has found that particles did not show a marked alteration in their movements when exposed to electrical influence. The results of many experiments point to heat as a probable cause, and although the peculiar movements of these particles appear like electrical attraction and repulsion, similar movements might be caused by the changes of temperature of the particles transmitted through the solutions.

GLASGOW PHILOSOPHICAL SOCIETY.

(Chemical Section).

Ordinary Meeting, January 31, 1870.

Dr. William Wallace, F.R.S.E., *Vice-President, in the Chair.*

Mr. John Christie, of Alexandria Turkey Red Works, Dumbartonshire, read a paper on "*The History of Madder, the Various Investigations Relating to its Character and Composition, and the Proposed Sources of Artificial Alizarine.*"

The author, with considerable detail, traced the history of madder dyeing, from its origin in Eastern India, 3000 years ago, through Persia, to Adrianople, Greece, Italy, and Western Europe. The colours were first obtained from Munjeet; then came into use the Turkey madder root. This plant was first grown in England in 1624, at which time three qualities were known—crop, fatt, and mill madders. In the year 1798 there were only eleven madder mills in the whole of France, while now in the department of Vaucluse alone there are no fewer than fifty in operation. French madder root has a peculiar smell, and a taste between bitter and sweet. Some kinds, as those of Alsace and Holland, when mixed with water and allowed to stand for some time, give a thick jelly; this is not yielded to the same extent by Avignon madder. If this madder is treated with an acid it produces a perceptible effervescence, owing to the quantity of calcic carbonate which it contains.

Towards the close of last century, scientific investigators and the more intelligent of the dyers and printers were led from various circumstances to suppose that madder contained two colouring matters, a red, and what they then called a

tawny colour. The author mentioned the results of the investigations of Watt, Charles Bartholdi, and Hausmann, and stated that, in 1823, M. T. Kuhlman published a complete approximate analysis of madder. That chemist found a red colouring matter, which he specially searched for, and another matter of a fawn colour, which he did not consider worthy of investigation. He prepared the red colouring matter by steeping madder roots in water for twenty-four hours, then boiling the washed madder with a fresh quantity of water, filtering the decoction hot, and then adding sulphuric acid, when a flocculent precipitate of an orange colour was produced. He again filtered and washed the precipitate with acidulated water. What he thus obtained was his *matière colorante rouge*. This he purified by dissolving in absolute alcohol, to which a small quantity of dry pulverised potassium carbonate was added; the alcohol acquired an intense crimson-red colour. After filtering and allowing the filtrate to evaporate spontaneously, he obtained small crystals like fern leaves, and having the following properties:—(1), Great solubility in alcohol, and imparting to it a beautiful red colour; (2), solubility in water, the colouring matter altering in the concentrated solution, and being precipitated; (3), the solubility in water greatly facilitated by alkalies without any material alteration of the shade; (4), it is precipitated as an orange colour from solutions by acids.

Mr. Christie next referred to the researches which were made on Alsace madder by Robiquet and Colin, and published in 1826. Those chemists obtained two colouring substances, one of them being what they considered no other than the particular colouring substance of madder, and which they named *alizarine*, from the modern Greek name for madder. The other substance they considered to be a modification of alizarine, and from the colour which it took when freed from the acid used to precipitate they called it *purpurine*. In the following year, by pursuing a somewhat different process, Gantier de Claubry and Persoz obtained two colouring matters—*matière colorante rouge* and *matière colorante rose*. Their distinctive properties are thus shown:—

Red.	*Rose.*
Fracture brilliant.	Fracture resinous.
Attacked by ammonia warm.	Attacked by ammonia cold.
Caustic alkalies give red colour.	Caustic alkalies give purple colour.
Insoluble in alum liquor.	Freely soluble in alum liquor.

In the hands of the same chemists madder yielded, by treatment with sulphuric acid, and subsequent washing with cold water, a preparation of great tinctorial power, which was at first called *sulphuric carbon*, and sometime later *garancine*. The manufacture of this substance on the large scale was undertaken by MM. Lagier and Thomas, of Avignon, in 1829.

The author gave a full outline of the investigations which Dr. Edward Schunck made in 1848. Seven substances were obtained by Schunck: two colouring bodies, two resins, a bitter substance, pectic acid, and a dark-brown substance. One of the colouring bodies was alizarine, to which he gave the formula, $C_{14}H_{10}O_4$; for the other, which he named *rubiacin*, he proposed the formula $C_{32}H_{22}O_{10}$. Pursuing a different process, Dr. Debus, in the same year, investigated Zeeland madder. He called one of the colouring bodies *rubric acid*, and proposed for it the formula $C_{30}H_{26}O_{20}$; and the other he called *oxy-lizaric acid*. Its composition was:—

Carbon	66·40
Hydrogen	3·86
Oxygen	29·74
	100·00

The last-mentioned substance was obtained to the extent of about 4 or 5 grains from 20 lbs. of madder.

Drs. Wolff and Strecker, pursuing a process very similar to Schunck's, obtained, in the year 1850, both alizarine and purpurine. The latter they regarded as oxide of alizarine. Their conclusions were summarised thus:—

I. Madder contains two colouring matters—alizarine and purpurine.

II. Alizarine changes into purpurine when madder is fermented.

III. Alizarine and purpurine, when oxidised with nitric acid, give phthalic acid.

IV. Chloronaphthalic acid is chloride of alizarine.

According to Strecker, if the formula of alizarine be taken as $C_{10}H_6O_4$, and one atom of chlorine be substituted for one atom of hydrogen, an interesting relationship is observable between that compound and chloroxynaphthalic acid, $C_{10}H_5ClO_2$. The author said it would thus seem likely that alizarine, or a body very similar to it, might be produced from chloroxynaphthalic acid. Schützenberger and Lauth have replaced the chlorine in that compound by hydrogen, but the new body had not the properties of alizarine, the composition of which, according to Schützenberger, is very probably $C_{20}H_{12}O_8$. P. and E. Depouilly, by boiling chloride of chloroxynaphthalic acid, $C_{10}H_5ClO_2.Cl$, with solution of potash, and subsequent treatment with mineral acids obtained as a yellow crystalline powder a body which sublimed in beautiful needles, and whose alumina salt is a deep red, like the colour given by madder. The iron salt is nearly black, and although it resembles alizarine in many points, Schützenberger states that trials made at Mulhouse to use it had not been satisfactory.

The next point referred to in the history of alizarine was the fact that Dr. Anderson, of Glasgow, had treated opianic acid, $C_{10}H_{10}O_5(=C_{10}H_6O_3+2H_2O)$, with sulphuric acid, and obtained a colouring matter which was probably alizarine, as it yielded all the madder colours on alumina and iron mordants. According to Clark, who obtained a patent for the process in 1861, artificial alizarine is obtained from dinitronaphthaline, and is capable of yielding all the madder colours. More recently Professor Rochleder, of Prague, has obtained, besides alizarine and purpurine, a small quantity of a colouring matter which reacts very like chrysophanic acid obtained from rhubarb root. When crystallised from absolute alcohol it has the composition $C_{14}H_{10}O_4$, and when it is distilled with powdered zinc it yields anthracen, $C_{14}H_{10}$. Graebe and Liebermann noticed that natural alizarine, by distillation with powdered zinc, yielded a hydrocarbon which, instead of being naphthaline, $C_{10}H_8$, as they expected, proved to have the same composition as Dr. Anderson, Berthelot, and others had given to anthracen, and believing that this was the proper source to start from in the preparation of artificial alizarine, they set to work to test the truth of the opinion. They were so far successful that they obtained a product closely allied in many of its properties to the colouring matter of madder, and in December, 1868, they obtained provisional protection for their process in this country. Mr. Christie detailed the process, stating that the patentees obtain in the first stage of the process anthrachinon, $C_{14}H_8O_2$, by the use of bichromate of potassium—

$$(C_{14}H_{10}+K_2Cr_2O_7=C_{14}H_8O_2+2KHO+Cr_2O_3).$$

In the second stage they convert the anthrachinon into bibromanthrachinon, $C_{14}H_6Br_2O_2$, a solid substance which is purified by crystallisation from benzol. In the third stage this new compound is transformed into artificial alizarine by treating with potash, heating to 180° or 260° C till a deep-blue colour results, then dissolving in water, filtering, and precipitating the alizarine by acid. They obtained provisional protection for a second patent last year.

Pursuing a somewhat different course, Julius Brönner and Hermann Gutzkow, of Frankfort-on-the-Maine, matured a process which they patented in May, 1869, and which, they state, yields two colouring matters that can be employed for dyeing or printing, either with or without mordants. One of them colours alcohol yellow, and the other colours it red or violet.

Mr. Christie completed his historical *resumé* by referring to Mr. W. H. Perkin's process, patented 26th of June, 1869, by which artificial alizarine is obtained from anthracene, by oxidising with bichromate of potassium to produce anthrachinon—a process which has recently been modified by the use of a new acid derived from anthrachinon in place of bibromanthrachinon.

The author then referred, at considerable length, to experiments which he had recently made with Perkin's artificial alizarine, and with one made by a secret process by MM. Lucius and Co., of Hoechst, near Frankfort. Amongst other things, he stated that while natural alizarine, prepared from the finest garancine, fused at 320° F., and was almost entirely sublimed by exposure to a temperature of 340°, the artificial alizarine only yielded a sublimate when the temperature was raised to 420° F. There was no fusion, and only 15 per cent of the powder was sublimed, even though it was kept at a temperature of 450° for a whole hour. No fusion ensued, and no further sublimate was produced, though the powder was slowly heated to 600°, at which temperature it was kept exposed for some time. Mr. Christie showed to the members an interesting experiment to demonstrate the truth of his opinion that artificial and natural alizarine are not identical. He placed swatches of dyed cloth in caustic soda solution (30 grs. to the gallon of water). Those dyed with the artificial alizarine of Perkin and Lucius and Co., in a short time threw off a deep crimson colour, which rose to the surface of the cloth, and, flowing down the swatch, fell in streaks through the alkaline liquor; while those dyed with natural alizarine and with garancine threw off no colour to affect the soda solution. He had found that selected crystals of artificial alizarine had only one-half the tinctorial power of the natural product. He concluded by saying that, from the several experiments which he had made, his opinion was that, although the substance now sold as artificial alizarine may be the best attempt to produce the alizarine of madder by chemical means, in its present state it is far from being identical with it.

A very animated discussion followed, in which Messrs. Anderson, Hogg, J. W. Young, Smith, Paterson, and the Chairman took part.

Mr. Hogg strongly combated the opinion that the two products are not identical. He questioned the absolute purity of Mr. Christie's artificial alizarine, and said that, unless it was not only sublimed, but several times recrystallised from alcohol, it would be impure; and, further, that the colouration imparted to the alkaline liquor was doubtless due to the presence of another colouring matter which is known to be present in ordinary commercial artificial alizarine. He also stated that mordanted cloth dyed with pure artificial alizarine stands soaping better than that dyed with garancine; that was the testimony of many persons who had worked with the colour.

Mr. J. W. Young said that he had found that cloth prepared with the artificial alizarine would stand even boiling with soap.

Mr. Smith stated that he considered that he had established the identity of the crystals of the two products by microscopic examination

In proposing a vote of thanks to Mr. Christie, the Chairman referred to the highly interesting nature of the enquiry, and complimented that gentleman upon the extensive researches in which he had been engaged, as shown by his very elaborate paper. The proposal was most heartily agreed to.

NOTICES OF BOOKS.

Our Domestic Fire-places. A New Edition, entirely Rewritten and Enlarged, the Additions completing the Author's Contributions on the Domestic Use of Fuel, and on Ventilation. By Frederick Edwards, jun. London: Longmans, Green, and Co. 1870.

This work treats on a most important subject, since it is one of the more difficult things in domestic economy to utilise fuel well, and to derive from it the greatest benefit with the least expenditure of combustible matter.

The work before us is divided into four chapters, and to each of these are added a series of lithographed plates for illustration. The first chapter treats chiefly on the history of fire-places and the substitutes in use even at comparatively recent times. We find recorded at page 5 that, at as late a period as the end of last century, before the introduction into England of the system of heating by hot-water circulation and by close stoves, large areas (including the Chamber of the House of Commons) were heated by charcoal or coke, burned in the open brazier. The second chapter gives a short account of the improvements in fire-places which have been effected during the present century. The third chapter treats on the improvements to be still effected in the domestic fire-place, and on the means for better diffusing the heat of the open fire-place, and thereby avoiding inequalities of temperature in the apartment. Under this heading, eight sub-sections are introduced, viz.—(1) By using the best form of grate; (2) by using the most suitable materials for the construction of the grate; (3) by improving the fire-bars; (4) by using the fire within a chamber of fire-brick and checking the supply of air from below; (5) by checking the escape of the warm air of the room into the chimney; (6) by giving a supply of air in proximity to the fire-place, instead of from doors and windows; (7) by doubly-glazing the windows—(As regards this particular, any one acquainted with the Continent must wonder at the fact that the mansions and abodes of the better classes are not more generally provided with double windows: this is a very frequent occurrence on the Continent, and contributes largely to retain the heat generated by fire-places); (8) by utilising the heat which escapes from the chimney. The fourth chapter is entirely devoted to the description of stoves, calorifères, and the various modifications thereof, and to such subjects as heating by hot water, hot air, and steam.

We regret that space forbids us to enter into even one or two of the many interesting details this work contains. It bears on every page the mark of careful research, and abounds to such an extent with useful matter that we should desire to see it studied and its contents brought into actual practice by all those who are in any way concerned with the important branch of domestic economy on which it treats.

As is usual with the eminent firm who published the work, its execution leaves nothing to be desired.

The Body and its Health; a Book for Primary Schools. By E D. Mapother, M.D., &c. Dublin: John Falconer. London: Simpkin, Marshall, and Co. Pp. 127.

It is an excellent sign of the increased desire of knowledge such as is contained in this little book, as well as of the excellence generally speaking of its contents, that the first edition was, as we learn from the brief preface, sold off in three days. *De tous les capitaux celui dont le peuple est le plus prodigue est leur santé* was long ago said by an eminent French *savant*. Health is wealth; and whatever promotes the first is highly conducive to the latter. How can we expect the "*mens sana in corpore sano*" where that *corpus* is neglected through sheer ignorance?

This book is filled with really useful knowledge, and treats on subjects of the highest importance. We have here an epitome of anatomy, physiology, dietetics, and hygiene rendered accessible and easily comprehended by the young readers it is intended for. Interspersed through the context, we meet with a great many brief facts relating to chemistry, which, since they are applied in a proper manner, are very useful; although on page 42, we think the reason given for the purity of sea and country air as being due to ozone, is one for the truth of which no sufficiently reliable data have as yet been found. Sea air undoubtedly contains some chlorine and always finely-divided, almost-pulverised salts.

Country air owes much, if not all, of its purity to its freedom from dust and smoke, the effects of meadows, and trees, and growing crops; to the absence of high buildings, the lesser impediments of free circulation; and last, but not least, to freely running brooks and water-courses.

The book is very well illustrated with a number of woodcuts; and it is not only excellent for the youth, but many full-grown people may be taught a useful lesson by its perusal.

The Pharmacopœias of the London Hospitals. By Peter Squire, F.L.S. London: Churchill and Sons.

The Pocket Guide to the British Pharmacopœia. London: Hardwicke.

Mr. Squire's well-arranged and capitally-printed book must prove of great service to the doctors. Arranged in groups for easy reference and comparison, it contains the pharmacopœias of seventeen London hospitals, and thus serves as a standard of the therapeutical practice of the present time.

The "Pocket Guide" seems to comprise the essentials of the British Pharmacopœia," conveniently arranged in a small compass for the busy practitioner to carry handily.

Acetopathy, or the Application of Medical Chemistry to Acute and Chronic Diseases. By Francis Coutts. Edinburgh: Bell and Bradfute; John Menzies and Co. 1870.

The author of this pamphlet makes the following assertion: "I have diligently studied medical chemistry for the past twenty years, and am happy to be able to announce my discovery of an agent applicable to almost every disease, and which is based on purely chemical principles. That agent is acetic acid."

After a perusal of this quotation, our readers will surely agree with us in thinking that any critical remarks of ours would be superfluous. We need only add that the *proper acid* to use is that tested by the author, the price of which is two shillings per quart bottle, and carriage!

Notes for Students in Chemistry; being a Syllabus of Chemistry and Practical Chemistry. By Albert J. Bernays, Ph.D., F.C.S., Professor of Chemistry and Practical Chemistry at St. Thomas's Hospital, London. Fifth Edition. 1870. Churchill.

We are glad to welcome a new edition of this little book. It has been considerably extended, and, as far as we have examined it, it appears to be remarkably accurate. Every chemist who takes it up will be struck with the vast mass of information which the author has condensed into a few small pages. The book really contains the essence of a bulky manual of chemistry. To students preparing for examination it must be invaluable.

CORRESPONDENCE.

Colophonic Hydrate.

To the Editor of the Chemical News.

Sir,—Observing in the Chemical News (vol. xx, p. 38; *Am. Repr., Sept.*, 1869, *page* 147) Mr. Tichbourne's account of colophonic hydrate, it may be worth while mentioning the result of an analysis which I made shortly before leaving England, in 1866.

Some white, needle-shaped crystals that had formed in an old sample of rosin-spirit were purified by sublimation and submitted to combustion. 0·112 grm. gave 0·239 CO_2 and 0·112 H_2O.

	Found.	$(C_{10}H_{16}+4H_2O)$.
Carbon	58·19	57·70
Hydrogen	11·11	11·53
Oxygen	30·70	30·77
	100·00	100·00

The crystals fused below 100° C. They were soluble in water and neutral.

I observed, about the same time, that crystals of a similar appearance quickly formed in rosin spirit which had been distilled in a current of steam.—I am, &c.,

Alexander M. Thomson.

University, Sydney, N.S.W.,
Dec. 2nd, 1869.

Reactions of Disulphide of Carbon with Baric and Calcic Hydrates.

To the Editor of the Chemical News.

Sir,—In Watts's "Dictionary" (vol. i., p. 776) the reactions of disulphide of carbon with the fixed caustic alkalies are given, but those with baric and calcic hydrates are omitted, nor are they to be found in any of the addenda. I have, therefore, thought that perhaps the following notes might be worth insertion.

A solution of baric hydrate, agitated with carbonic disulphide, rapidly turns to a dark purplish brown colour, changing to a dirty green, and, lastly, to a brownish yellow solution with a small quantity of dark brown deposit, this final result being precisely similar to that obtained after a much longer period of time with sodic or potassic hydrate, as, in the time required to produce the purplish brown colour with the baric hydrate, a pale brownish yellow only could be obtained with the sodic or potassic hydrate. A solution of calcic hydrate with carbonic disulphide produces, after long stirring and standing, only a pale brownish yellow solution, a result to be expected from the inferior solubility of the calcic to the other hydrates. The reaction is, of course, similar in all cases, viz., the formation of carbonates and sulpho-carbonates.—I am, &c.,

Henry Mathews.

The Bessemer Process for Making Steel.

To the Editor of the Chemical News.

Sir,—Mr. Norman Lockyer, in his lectures upon the spectroscope, delivered a few weeks ago before the Society of Arts, stated that this instrument was of great service in directing the Bessemer process of making steel; I have, however, been informed by others that it is perfectly useless for this purpose, since it does not afford any indication denoting that the blast has been kept on for a sufficient length of time.

Perhaps Mr. Lockyer, or some other gentleman, will kindly publish sufficient of his *practical experience* to settle this question. Such an act of courtesy will oblige both your correspondent and many other students.—I am, &c.,

A. B.

Spectrum of the Bessemer Flame.

To the Editor of the Chemical News.

Sir,—In the last number of the Chemical News there is an inquiry respecting the application of spectrum analysis to the Bessemer process of making steel, to which I am able to give a tolerably definite reply. I have not myself been called upon to use it practically, but have had frequent opportunities for examining the flame and of hearing the results of the great experience in the manufacture of the steel at the works of Sir John Brown and

Co., from my friend Mr. W. Bragge, who was the first to suggest its application, and employed Professor Roscoe to make the necessary observations. Though a well experienced person can determine the time when the blast should cease, from the general colour of the flame, yet I am informed that a direct-vision spectroscope is found to be of great value, and is often employed.

According to my own observations, the flame at first gives a continuous spectrum without bright or dark lines, but in a while the sodium line appears, and afterwards several bright red, green, and other lines. There are also developed dark lines, as if from absorption, which becomes more and more distinct, and then more and more faint; and when the spectrum is just free from these dark lines the blowing should cease. I am informed that there are certain special lines which should be carefully observed, but I am unable to describe them definitely. As far as I have been able to judge, the spectrum method would very much assist a comparatively inexperienced observer, but I am by no means persuaded that it would be sure to give better results than those attainable by experience from the general colour of the flame, as seen by the naked eye; though, even in that case, it might be valuable for particular purposes. On adding the spiegeleisen, dark bands are again seen, so as to give rise to a most remarkable spectrum.—I am, &c.,

H. C. Sorby.

Broomfield, Sheffield.
February 14, 1870.

Spectrum of the Bessemer Flame.

To the Editor of the Chemical News.

Sir,—Your correspondent "A. B." will find reliable information on the application of the spectroscope to this process in Roscoe's "Spectrum Analysis," p. 107. The workmen invariably tell the proper time to stop the blast by a change in the appearance of the flame. Although I have watched the process very many times, I was never able to determine the precise point with any exactitude from the appearance of the flame to the naked eye, but with the spectroscope it is easy to determine the point with the utmost exactitude. The temperature of the flame steadily increases from the commencement of the blow until the blast is stopped. About six or eight minutes after the blast has been turned on, a group of red lines makes its appearance; this group is characteristic of carbon and increases in brightness until the carbon has been all burnt out of the iron, when it suddenly disappears.

It is thus extremely easy by watching this group to determine the exact point at which the blast should be stopped, and when watching the flame with the spectroscope I found that the time during which the blast was continued, under the direction of the manager, often differed, sometimes by as much as eight or ten seconds from the proper time as tested by the spectroscope, and by observing whether the charge had been "underblown" or "overblown," I was able uniformly to predict the quality of the steel. Those engaged in the process say that the spectroscope is useless, that it is of no consequence, that the process requires to be watched by a practised eye, and that they prefer to make steel of various qualities to be afterwards sorted than to make steel always of one quality. The experiments which I carried out on this subject at Crewe gave extremely interesting results, and I have no doubt that valuable information as to the change which takes place might be obtained by a further spectroscopic examination of the flame.—I am, &c.,

W. Marshall Watts.

Manchester Grammar School.

Spectrum of the Bessemer Flame.

To the Editor of the Chemical News.

Sir,—In answer to your correspondent "A. B," I can assure him that the spectroscope is quite capable of indicating the period of "blowing" in the Bessemer process.

By examining the flame through certain coloured glasses, the changes occurring in it can be more easily determined, however. Two blue glasses with a dark yellow glass between give the best combination, and can be used with safety by the most inexperienced, as its indications are so marked and unmistakable.

For further information on this subject I refer "A. B." to a paper I read before the chemical section of the Philosophical Society of Glasgow, "On the Examination of the Flame of the Bessemer Converter," which was published in the Chemical News of April 9, 1869 (*Am. Repr. June*, 1869, *page* 286), or he can have the paper in the form of a pamphlet by sending me his address.—I am, &c.,

Thomas Rowan.

Laboratory, 42, Bath Street, Glasgow.
February 14, 1870.

Brown's Active Molecules.

To the Editor of the Chemical News.

Sir,—Will you allow me to suggest that if Professor Jevons examines the interesting phenomena brought by him before the Manchester Microscopical Society, and reported in your last number, on the principle of the surface tension of liquids, he will find the clue he is in search of.—I am, &c.,

C. Tomlinson.

Highgate, N., February 14, 1870.

Trivalent Elements.

To the Editor of the Chemical News.

Sir,—In the Chemical News (vol. xx., p. 293; *Am. Repr., Feb.* 1870, *page* 80), Mr. J. A. Wanklyn brings forward a new theory of the equivalency of sodium. Sodium has generally been regarded as a monad element, which degree of chemical force it exhibits in most of its salts; but when we arrive at the so-called double salts (the chloro platinates and the chloriodides, for instance), this monovalency of sodium is extremely vague.

But it must be remembered that shifting the equivalency of one element is a difficult process; for we know that potassium forms salts which are analogous in composition, if not in constitution, with those of sodium. Mr. Wanklyn objects to the hydrate of sodium being written as derived from water, on account of its caustic and extremely active properties; whilst the original type is, in itself, an admirable example of neutrality. Potassium hydrate, being analogous in composition, and possessing the same properties, it is quite rational to expect their constitution should be the same. The simple salts of the two metals can be thoroughly explained by the new theory, as Mr. Wanklyn himself shows in the case of sodium; but there is a point of much more importance than this and that—the explanation of the constitution of the double salts.

Although we have no combination of three monads with sodium or potassium, we have compounds in which sodium unites with an apparently triad element. Thallium, in certain respects, acts as an atom of potassium—it forms a hydrate, chloride, &c. This metal is classed as a triad; and why not sodium and potassium? Triad thallium unites with triad iodine. Triad potassium also unites with iodine.

Thus it may be seen that the alteration of equivalency as proposed by Wanklyn is of unlimited application as regards the now-denominated monad metals. Fownes's "Manual" (p. 360) contains a foot-note, to the effect that, if the formula for argentous oxide (Ag_4O) is correct, oxygen must be a tetrad. And, on the preceding page, chlorine is made to act as a triad, in order that the constitution of argenteous chloride may be explained; but, by classing silver as a triad, the difficulty vanishes—

$$\left.\begin{array}{l} Ag''' \\ \| \\ Ag''' \\ | \\ Ag''' \\ \| \\ Ag''' \end{array}\right\} O'' \qquad \begin{array}{l} Ag'''-Cl \\ \| \\ Ag''' \\ | \\ Ag''' \\ \| \\ Ag'''-Cl \end{array}$$

Argentous oxide. Argentous chloride.

But, to return to the compounds of sodium and potassium, Wanklyn gives sodium iodide as $INa''' = Na'''I$; but the existence of iodine trichloride is sufficient evidence for the support of the trivalency of that element. If there exist, however, in the molecule *two atoms* of the haloid constituent, we must refer iodine back to the monad list: but, at present, it certainly appears as a combination of two triads—$Na'''I'''$.

Extending the use of this polyvalency of sodium and the analogous metals, we may demonstrate the constitution of the alkaline sulphides, and their subsequent transformation into sulphates under the influence of oxidising agents, sulphur appearing in its highest degree of chemical force—

$$S^{vi}\left\{\begin{array}{l} Na''' \\ Na''' \end{array}\right. \qquad O_2''S_v\left\{\begin{array}{l} Na'''O'' \\ Na'''O'' \end{array}\right.$$

Sodium sulphide. Sodium sulphate.

These formulæ also extend to the potassium and silver salts. But difficulties soon arise; for, by giving to potassium or sodium chloroplatinate the formula—

$$\left.\begin{array}{l} Na''' \\ | \\ Pt^{iv} \\ | \\ Na''' \end{array}\right\} Cl_6$$

we must ignore the existence of the hydrogen salt, unless we give hydrogen also a triadic signification.

The following formulæ will, perhaps, give an idea of the so-called double salts:—

$$\begin{array}{l} Cl \\ | \\ Na'''-Cl \\ | \\ Au'''-Cl \\ | \\ Cl \end{array} \qquad \left.\begin{array}{l} Na''' \\ | \\ Al^{iv} \\ | \\ Al^{iv} \\ | \\ Na''' \end{array}\right\} Cl_8$$

Sodium chloro-aurate. Sodium chlor-aluminate.

$$\left.\begin{array}{l} \left\{\begin{array}{l} K''' \\ K''' \\ K''' \end{array}\right. \\ | \\ Rh^{iv} \left\{\begin{array}{l} K''' \\ K''' \\ K''' \end{array}\right. \end{array}\right\} Cl_{12} \qquad \left.\begin{array}{l} \left\{\begin{array}{l} K''' \\ K''' \\ K''' \end{array}\right. \\ | \\ Ir^{iv} \left\{\begin{array}{l} K''' \\ K''' \\ K''' \end{array}\right. \end{array}\right\} Cl_{12}$$

Potassium chlor-rhodiate. Potassium chlor-iridiate.

The above formulæ will show that Wanklyn's views admit of much extension; being in the same isomorphous group as thallium, and acting as that element in all but the thallic salts, sodium, potassium, and silver, although their poly-haloid combinations have not yet been discovered, are with all probability trivalent elements.—I am, &c.,

GEORGE E. DAVIS.

Eton, Feb. 7, 1870.

Reactions of Disulphide of Carbon with Baric and Calcic Hydrates.

To the Editor of the CHEMICAL NEWS.

SIR,—With reference to a letter on the above subject in your last number from Mr. H. Matthews, I have several times observed a reaction between calcic hydrate and carbonic disulphide, which I have not seen mentioned anywhere, and which you may, perhaps, think worth recording.

Instead of using a solution of lime in this reaction, if milk of lime be employed, and if this be agitated with carbonic disulphide for a short time and then allowed to stand, in the course of twenty-four hours bright orange-red coloured needles will begin to make their appearance in all parts of the sediment. They slowly spread and increase in number and size and in a month or more will have accumulated in considerable quantities.

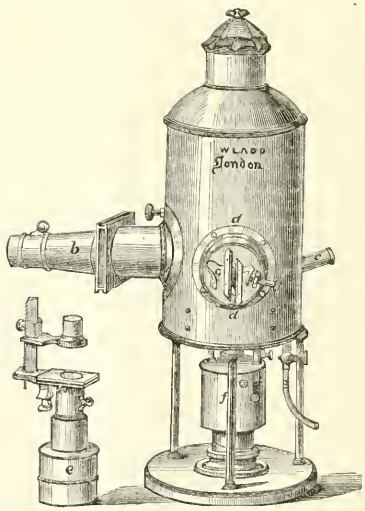
Not having analysed this product, I am unable to say whether it consists of calcic sulphide or of calcic sulphocarbonate.—I am, &c.,

J. GULSON BURGESS.

Leicester, Feb. 9, 1870.

MISCELLANEOUS.

Improved Electric Lantern.—Since spectrum analysis has been discovered a great inconvenience has been felt by lecturers in being compelled to use two lanterns—one for exhibiting the spectrum, and the other to project on the screen a direct ray of light, a photograph, or other object. When only one lantern was used it was requisite to disconnect the apparatus, and revolve the lantern in order to project the object on the screen, and as it has been found incon-



venient to show all the spectrum experiments together, and diagrams, &c., afterwards, the loss of time in getting the prisms and lenses to their required position, and re-adjusting the lantern, is considerable. These inconveniences Mr.

Ladd has entirely overcome by his new form of lantern, which is provided with two openings—one placed facing the screen, and the other at an angle of about 100° from it, this being about the proper angle when two prisms containing bisulphide of carbon are used for producing a spectrum. But as the angle must vary, according to the distance from the screen, one of the openings is provided with an adjustment for that purpose. The lantern is also provided with a small opening at the back, at the same height as the other two, for the reception of a sliding tube, carrying a lens at one end which focuses on a piece of ground glass, at the other an image of the carbon points. This enables the operator not only to see what is going on at the points, but also to keep them at an exact height, so requisite in many experiments. As an example of the utility of this arrangement, we will suppose the operator wishes to project on the screen an image of the arc as well as the spectrum of any particular substance; to do this he closes the slit, and focuses the arc by means of the optical arrangement facing the screen, and while the metal is still burning he closes this opening and opens the slit, when immediately a spectrum of the substance appears in the same part of the screen. The lantern is entirely of metal, and is also provided inside with a gas-jet and stopcock to enable the operator to perform his work in a darkened room.

Correlation of Vital and Physical Forces.—Preliminary trials having shown that any change of temperature within the skull was soonest manifested externally in that depression which exists just above the occipital protuberance, a pair of these little (thermoelectric) bars was fastened to the head at this point; and to neutralise the results of a general rise of temperature over the whole body, a second pair, reversed in direction, was attached to the leg or arm, so that if a like increase of heat came to both, the electricity developed by one would be neutralised by the other, and no effect be produced upon the needle, unless only one was affected. By long practice it was ascertained that a state of mental torpor could be produced, lasting for hours, in which the needle remained stationary. But let a person knock on the door outside the room, or speak a single word, even though the experimenter remained absolutely passive, and the reception of the intelligence caused the needle to swing through 20°. In explanation of this production of heat, the analogy of the muscle at once suggests itself. No conversion of energy is complete; and as the heat of muscular action represents force which has escaped conversion into motion, so the heat evolved during the reception of an idea is energy which has escaped conversion into thought, from precisely the same cause. Moreover, these experiments have shown that ideas which affect the emotions, produce most heat in their reception; a few minutes' recitation to one's self of emotional poetry, producing more effect than several hours of deep thought. Hence it is evident that the mechanism for the production of deep thoughts accomplishes this conversion of energy far more perfectly than that which produces simply emotion. From a Lecture by Professor G. F. Barker, before the American Institute, reported in the *Scientific American*.

Sweating Gold Coins.—The trial of Clifford for sweating gold coin presents many points of interest. It is the first case of the kind for thirty years. The facts were as follows:—The attention of the police being directed to a number of light sovereigns that found their way into circulation in a certain district, the coins in question were traced to a little girl, who, it appeared, acted for her father. When Clifford was arrested, he was seated in front of a battery, and although he may not have been working at the moment, still two sovereigns, each light to the extent of nearly two shillings, were found in his pocket. The scientific witness, Mr. W. Chandler Roberts, clearly showed that the wires that had sustained the sovereigns in the decomposition trough had been attached to the positive or dissolving electrode, and that the battery had not been employed for electro-gilding. Clifford threw into the fire the contents of a tea-cup, and as the chemist of the Mint produced in court gold extracted from the cinders, it is probable that the fluid was the actual solvent employed. Commenting on this, the *Pall Mall Gazette* says:—"In an official report bearing the signatures of the late Master of the Mint and Colonel Smith, F.R.S., it was suggested that a Mint charge should be imposed upon gold coin sufficient to defray not only the first cost of manufacture, but also the expense of replacing the worn coin after a certain period by new pieces of standard weight. It was proposed that as a coin would fall below current weight in eighteen years, it should be brought to the Mint at the expiration of that period and exchanged for a new piece. The recent trial of Clifford for sweating sovereigns by the aid of an electric battery, and more especially the evidence of the scientific witness as to the facility with which such an operation can be carried out, suggests that if the plan in question were adopted, a positive bribe would be offered to ingenious but dishonest individuals to tamper with the coinage, and then present the damaged coin for exchange at the Royal Mint."

Chemistry in the House of Commons.—We are glad to find that Mr. U. J. Kay-Shuttleworth has been elected Member of Parliament for Hastings. Mr. Shuttleworth possesses a thorough knowledge of chemistry, and is the author of a valuable text-book for students. He will, we are sure, prove a warm advocate of technical education, and at no time has it been more important to send scientific men to Parliament than the present, when the great question of education is to be brought forward, and, we hope, settled in a manner satisfactory to all classes.

Preparation of Alizarine from Madder.—M. Schützenberger.—Take some yards' length of genuine Turkey red dyed cotton which has been cleansed (*avivé*), cut it up in suitable pieces, best ribbon-like shreds; pour upon it a quantity of strong alcohol (85 per cent strength) well acidified by means of concentrated sulphuric acid, and digest for some days without application of heat; pour off the liquid from the rags and saturate accurately with ammonia (excess is carefully to be avoided), when, by a mixture of ammonia and sulphate of alumina, alumina is thrown down. This is separated by filtration, and the filter washed with some alcohol; the liquid is next concentrated by evaporation on a water-bath, and afterwards water is added, causing a precipitation of mixed fatty and colouring matter; this precipitate is thoroughly dried, and, when dry, exhausted with rectified sulphide of carbon, which dissolves fatty matter, leaving almost perfectly pure alizarine, which, however, if desired, may be sublimed by being placed in a porcelain capsule, and heated on a sand-bath to about 250°. This method yields a pure substance, and, as regards quantity, a very satisfactory result, while the operation is far easier than when either madder or its alcoholic extracts are employed.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the month, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note.—*All degrees of temperature are Centigrade, unless otherwise expressed.*

Archive Neerlandaises des Sciences Exactes et Naturalles, vol. xiv., 1869

Extent of Surface Occupied by the Deposits of the Various Geological Formations in the Netherlands.—M. Hartogh Heys van Zouteveen.—From this paper, we learn that the following geological formations are found in the kingdom above named:—Jurassic terrain; cre-

taceous terrain tertiary formation; quartair formation. sub divided into diluvium and modern, or recent formations. The extent of each, and of every distinct species thereof, is accurately exhibited; the curious result arrived at is that 99·9 per cent of the soil of the Netherlands belongs to the quartair formation, while all the rest occupies only about 0·1 of the entire surface (3,283,927 hectares). fully more than 13,000 English square miles. No other country on the face of the globe presents a similar physical constitution.

Estimation of the Velocity by which a Luminous Ray is Carried Forward through a Moving Medium.—M. Hoek.

Refraction and Dispersion of Flint Glass, Crown Glass, Quartz, and Iceland Spar.—MM. van der Willigen.

Comptes Rendus des Séances de l'Académie des Sciences, January 17, 1870.

This number contains the following papers and memoirs relating to chemistry and allied sciences:—

General Theory of Chemical Action and the Necessity of its Introduction and Use to Prevent Errors being made.—M. Maumené.—This paper was read, but is not published. From an account of the meeting at hand, we learn that this very revolutionary chemical paper, containing direct attacks upon the most eminent living, as well as deceased, authorities of chemical science, has been remanded to the section for chemistry.

Dispersion of Light.—M. Ricour.—A continuation of a former paper on this subject, and strictly algebraico-physical.

Some Silicified Vegetables met with near Autun.—M. Regnault.

Nickelisation.—M. Gaiffe.—The author states, in a letter read at the meeting by M. Dumas, that he desires to call the attention of the members to a variety of objects electro-nickelised, sent to the place of meeting. He also calls attention to the fact that the presence of even the smallest quantity of potassa, or soda, or alkaline earths in the bath containing the nickelising preparation is injurious to effect a properly-adhesive coating of the metal. The use of perfectly pure double chloride of nickel and ammonium, or of perfectly pure sulphate of nickel and ammonium, and, moreover, of pure nickel, as one of the electrodes is required. By these means, the nickel is made to adhere regularly and strongly, and only requires polishing after the metal coated over is taken from the bath.

Spectra of the Simple Gases.—M. Wüllner.—This paper is a defensive reply from the author against the remarks made by M. Dubrunfaut on his former paper concerning this subject.

Synthesis of Normal Propylic Alcohol by Means of Ethylic Alcohol.—M. Rossi.—The author converts chloride of ethyl into cyanide of ethyl, and next converts that cyanide, by means of well-known methods, into propionic acid. From the lime-salt of that acid propionic aldehyde is obtained; this is a clear, very mobile liquid, soluble in water, exhibiting a suffocating odour, boils at 49·5° at 740 m.m. barom., sp. gr. at 17°, 0·804; formula, C_3H_6O. By hydrogenising this aldehyde, the propylic alcohol is obtained. After having been purified, this liquid exhibits the following properties:—Boils at 96°; barom., 743 m.m.; sp. gr. at 0, 0·8205; formula, C_3H_8O. The author describes, at some length—Bromide of propyl, C_3H_7Br; iodide of propyl, C_3H_7I; cyanide of propyl; acetate of propyl—

$$\left.\begin{matrix}C_2H_3O\\C_3H_7\end{matrix}\right\}O.$$

January 24, 1870.

This number contains the following memoirs and papers relating to chemistry and allied sciences:—

Electro-Depositing of Nickel upon Other Metals.—M. Becquerel.—Eight years ago, the author applied, for the purpose of electro-deposition of nickel upon other metals, the same method as described at the previous meeting by M. Gaiffe and his associates. M. Becquerel now states that, since the last meeting, he has purposely repeated some of his former experiments, with the express view of ascertaining whether the statement made by M. Gaiffe, concerning the injurious action of the presence of potassa be correct or not. The result of experiments is that the presence of potassa is not at all injurious to, and in no wise affects, the deposition of nickel, since the double sulphate of nickel and potassa can be applied, as well as the double sulphate of nickel and ammonia; but if the positive electrode is not made of nickel, it is necessary to add free ammonia, in order to saturate the sulphuric acid which is set free.

Election of a New Corresponding Member.—M. Kirchhoff has been elected corresponding member, in lieu of Mr. Forbes, deceased.

Discovery of Diamond at Diaschkowitz (Bohemia).—M. Schafaritz.—At 60 kilometres (37·26 English miles) north-west from Prague, in a mining district belonging to Count Schonborn, a stone was found a few weeks ago, which, on having been forwarded for assay to the Polytechnic School at Prague, turned out to be a diamond. Its weight is 57 milligrms.; sp. gr., 3·52; its shape, irregular; its crystalline form, a rhomboidal dodecahedral. This discovery is interesting in more than one respect—in the first place, this specimen is the first genuine diamond found in Europe (the Ural mountains produce diamonds, but not on European territory); secondly, because of the geological formation wherein this specimen occurred, a formation quite different in character from that wherein diamonds have been found hitherto in other parts of the world. The locality alluded to is stated by the author to yield several other kinds of precious stones.

Constitution of Luminous Spectra.—M. Lecoq de Boisbaudran.

Freezing of Water, and on Saturated and Non-Saturated Gaseous Solutions.—M. Barthelemy.—This paper contains the description of some experiments made with the view to explain some irregularities observed by the author when ice was formed at −10° or −12° under peculiar conditions. The author states that, as result of his experiments, the so-called, or, rather, averred explosive force of ice is untenable and does not agree with its plasticity, and that the gases contained in the water, becoming liberated and compressed by the formation of ice, are the cause of the explosive action of that material.

General Theory of Chemistry; Preparation of Oxy-Ammonia.—M. Maumené.—The author's chief aim is to explain, by a peculiar theory of his own invention, certain reactions which take place when nitrate of ammonia, or other alkaline nitrates, are acted upon by nascent hydrogen. 200 grms. of nitrate of ammonia are mixed with 2170 grms. of hydrochloric acid (sp. gr. 1·12) and 552 grms. of tin, and care taken to keep this mixture in a very cool flask or retort. After the action is finished, the fluid is treated with sulphuretted hydrogen, next, some alcohol is added, and also some chloride of platinum. After proper purification, a substance is obtained which is soluble in absolute alcohol, and containing 52·6 per cent of hydrochloric acid; mixed with oxide of copper, this substance yields deutoxide of nitrogen. When pure chloride of ammonium is acted upon by a solution of nitrate of silver, care being taken to leave a slight excess of the former salt—in this sense, that there be not enough nitrate to decompose the

chloride entirely, there is formed (after filtration, of course), a liquid which, concentrated by evaporation to a syrupy consistence, deposits a peculiar salt, which, at a comparatively low temperature, gives off deutoxide of nitrogen.

Variable State of Electric Currents, and on Extra Currents.—M. Blaserna.

Experiments on the Intrapolar Currents of a Grove Element.—M. Royer.

Nature of Ozone.—M. Dubrunfaut.—We shall return to this paper.

Improvement of Wines by Electricity.—M. Scoutetten.—The author states, in the first place, that a series of experiments, made on the large scale and with various sources of electricity, led to the result that electricity, under whatever form applied (whether as a regular current or a succession of discharges accompanied by sparks), improves wine, rendering it mellow and mature. As to the mode of action of this agent, the author thinks that the bitartrate of potassa present in wine is decomposed: the potassa set free saturates the acids of the wine, and the free tartaric acid, reacting upon the fatty matters present, favours the formation of the ethers which constitute the *bouquet* of the wine. Moreover, a small quantity of water is decomposed, and the oxygen thereof reacts upon some of the constituents of the wine, thereby forming new compounds which are peculiar to old wines.

Cosmos, January 22, 1870.

Artificially-Prepared Alizarine.—The Société Industrielle de Mulhouse has just proposed to grant its medal of honour to him who shall introduce artificially-made alizarine at a sufficiently low price, so that it may be available for general use, instead of and to perfectly answer all the purposes to which madder or its preparations are now applied in calico-printing and dyeing. The competitor is bound to make and deliver a quantity of this product equal to, at the least, 40,000 kilos. (40 tons' weight) of madder; the product, moreover, must be such that, by the methods of mordanting, &c., now in use, it will yield the same shades of colour and of the same good quality as madder or its preparations. This notice also states—(1) That the artificially-made alizarine prepared by MM. Meister, Lucius and Co., at Hoechst, near Frankfort, yields, especially for red and puce, results which leave nothing to be desired. (2) M. Pernod, from Avignon,* have just requested MM. Steinbach and Rack, of Mulhouse, to report upon the tinctorial value of a sample of a newly-discovered pigment extracted from the wash-waters of the madder while being converted into garancine; the same gentlemen have also been requested to report upon a sample of oxalic acid obtained from the same source.

Detection of Butyric Acid in Glycerine.—M. Pérutz.—According to the author, concentrated glycerine should simply be mixed, for this purpose, with very strong alcohol and concentrated sulphuric acid, when butyric ether is at once formed and easily recognised by its peculiar pine apple-like smell. Since glycerine often contains large quantities of butyric acid, the author proposes to treat with alcohol the animal charcoal employed for the decolouration of the glycerine; the butyric acid is retained between the pores of the animal charcoal in the state of butyrate of lime soluble in alcohol. The material thus recovered may be applied to the manufacture of butyric ether or butyric acid.

January 29, 1870.

Gold Found in the Rivers of the Scandinavian Peninsula.—M. Meunier.—The quantity of gold dust occurring among the sand of the beds of the northern rivers of Sweden and Norway is larger in quantity than has been hitherto generally known: three men have made, within six weeks, a sum of £80 each, by washing the sand and collecting the gold contained therein of one of the rivers.

Annalen der Chemie und Pharmacie, December, 1869.

This number contains the following original memoirs and papers:—

Ketonic Acids.—M. Wichelhaus.—The intention of the author is to point out the limits, and reduce to regular classification the products of the oxidation of hydrocarbons. There are four different modes by means of which an atom of oxygen can combine with a hydrocarbon (provided the relative position of the carbon atoms remains unaltered.) The following are instances of these four types:—

$CH_2.OH$	$CO\ H$	CH_3	CH_2 } O
$CO\ .OH$	$CO.OH$	CO	CH }
		$CO.OH$	$CO.OH$
Alcohol. or oxy acid.	Aldehyde acid.	Ketonic acid.	Oxy acid.

The paper next contains the following separate sections:—Relation of pyro-uvic acid and acetone—

CH_3	CH_3
CO	CO
CH_3	$CO.OH$
Acetone.	Pyro-uvic acid.

(pyro-uvic acid bears the same relation to acetone as propionic acid to propan); products of the action of bromine upon pyro-uvic acid; substitution products of bibromo-pyro-uvic acid; distillation of pyro-uvates.

Naphthol and Carbonaphtholic Acid.—M. Eller.—When diazo-naphthaline prepared by means of the action of nitrous acid upon naphthylamine, is boiled with water, naphthol, $C_{10}H_7.OH$, is obtained; but this mode of preparing naphthol, although modified in various ways by the author, only yielded traces of the substance alluded to. The author, therefore, considered it better to prepare naphthol by means of the decomposition of naphthaline sulphoacid salts by fusing caustic potassa. The fused mass is first dissolved in water, decomposed by means of hydrochloric acid, and, after a further purifying process, naphthol is obtained as snow-white brilliantly-crystalline solid substance, fusing at 92°; formula, $C_{10}H_8O$. When naphthol is acted upon by sodium and carbonic acid, it yields a new product, carbonaphtholic acid, $C_{11}H_8O_3$, or—

$$C_{10}H_6 \begin{cases} OH \\ CO.OH, \end{cases}$$

a solid substance, hardly soluble in water, readily so in benzol, ether, and alcohol, and fusing at about 187°. The salts of this acid are all rather difficultly soluble in water.

Isomeric Naphthols and some Derivatives thereof.—M. Schæffer.—In the introduction to this paper, the author refers, at some length, to the researches on this subject, first and foremost of Faraday, and next of MM. Liebig, Regnault, Berzelius, Wöhler, and many others. There exists—a naphthol, $C_{10}H_7.OH$, obtained from naphthalin-sulphate of lead; this a product is characterised by its behaviour with hydrochloric acid; for, if a splinter of fir-wood is dipped, first into an aqueous solution of α naphthol, and then in hydrochloric acid, and then exposed to sunlight, the wood is first coloured green, and at last a brownish red colour. β naphthol also exhibits this reaction, but it is more rapidly performed: and when the wood is dipped afterwards in a weak solution of bleaching powder, a yellow tinge is produced. The author describes, at length, naphthol-ethyl ether, $C_{10}H_7.OC_2H_5$; naphthol-ether, $C_{12}H_{12}O$; α and β naphthol-acetyl-ether, $C_{10}H_7.OC_2H_3O$;

* There is no firm in existence so largely interested in the trade and everything relating to madder, garancine, &c., as this very extensive commercial and manufacturing firm.

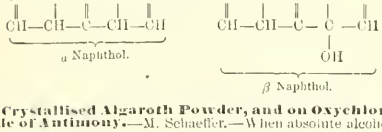
phosphate of naphthol-ether, $PO_4(C_{10}H_7O)_3$; carbonaphtholic acids; α and β naphthol-sulpho acids—

$$C_{10}H_6 \left\{ \begin{array}{l} OH \\ SO_3H, \end{array} \right.$$

and several of its salts.

Derivatives from Naphthaline.—MM. Darmstädter and Wichelhaus.—A lengthy memoir divided into the following sections:—Binitro-naphthol and bichloro-naphtho-chinon from α naphthol; dinitro-naphthaline; bromo-sulpho acids of naphthaline; naphtho-bioxyl; bicyanide of naphthaline; bicarbo-naphthaline acid.

Contribution to the Knowledge of the Constitution of the Derivatives from Naphthaline.—M. Wichelhaus.—We reproduce the formulæ in this paper, since they are, according to the author, the formulæ expressing the constitution of the naphthols—



α Naphthol. β Naphthol.

Crystallised Algaroth Powder, and on Oxychloride of Antimony.—M. Schaeffer.—When absolute alcohol and chloride of antimony are placed together in a sealed tube and heated to about 150°, in the proportion of 1 molecule of chloride of antimony and 3 molecules of alcohol, there is found, on opening the tube, that, while chloride of ethyl escapes, the sides of the tube are lined with a crystalline mass, which, after having been thoroughly washed with alcohol, proved to consist of chlorine and antimony, without any organic substance, the formula being $Sb_4Cl_2O_5$, the same which has been adopted for the *Pulvis algaroth* of the pharmaceutists. Another experiment, made with equal molecules of alcohol and chloride of antimony, led to the formula $SbOCl$; and the reaction is represented by—

$$SbCl_3 + C_2H_6O = Sb \left\{ \begin{array}{l} OC_2H_5 \\ Cl_2 \end{array} \right\} + HCl; \; Sb \left\{ \begin{array}{l} OC_2H_5 \\ Cl_2 \end{array} \right\} = \\ = SbOCl + C_2H_5Cl.$$

Constitution of Epichlorhydrine.—M. Darmstädter.—By first causing chloride of phosphorus to act upon epichlorhydrin, and next adding to the product so obtained a quantity of bromine, a fluid was obtained which, by means of fractional distillation, yielded a liquid boiling at about 200°; sp. gr., at 15°, 2·004; formula, C_3H_5BrCl. This substance is identical with chlorhydrodibromhydrine; and the author states that the following formula—

$$\left. \begin{array}{l} CH_2Cl \\ CH \\ CH_2 \end{array} \right\} O + PCl_3, Br_2 = \left\{ \begin{array}{l} CH_2Cl \\ CHBr \\ CH_2Br \end{array} \right\} + PCl_3O$$

represents the reaction, and thus proves the correctness of the view that epichlorhydrine does not contain hydroxyl.

Preparation of Zinc Ethyl.—M. Wichelhaus.—The gist of this paper is that it is best to apply, for the purpose of the preparation of zinc ethyl, coarsely-divided, that is to say, roughly-filed, zinc, which exhibits a great many points of contact.

Aceto-Chlorhydrine from Octyl-Glycol.—M. Clermont.—The author describes, at some length, the preparation and rectification of aceto-chlorhydrine by means of anhydrous acetic acid, anhydrous hypochlorous acid, and pure octylen. The aceto-chlorhydrine thus obtained is a very mobile, colourless liquid, exhibiting a pleasant aromatic odour and burning taste, insoluble in water, but soluble in alcohol, ether, and acetic acid; it is capable of burning, with a smoky greenish coloured flame; boils at 225°, without decomposition; sp. gr. at 0°, 1·026; formula, $C_{10}H_{19}ClO_2$; vapour density, 7·12. On being treated with caustic potassa in a sealed tube at 180°, a liquid was obtained boiling at 145°; formula, $C_8H_{16}O$—that is to say, octylen oxide.

Uric, Formic, Glycolic, and Glyoxylic Acids, Products of the Oxidation of Glycerine by Nitric Acid.—M. Heintz.—A lengthy memoir, wherein the author minutely describes the method applied by him for proving the four substances named to be produced when glycerine is acted upon by nitric acid.

Contribution to the Knowledge of Sulpho-Nitrogen Acids (Schwefelstickstoffsauren Corps Sulfazotes of Fremy).—MM. Claus and Koch.—This paper, having also appeared in another German periodical, has already been abstracted (see Chemical News, vol. xx., p. 323; *Am. Repr., February*, 1870, *page* 114).

Observations and Critical Remarks upon M. Linnemann's Paper "On the Conversion of Butyric Acid into Normal Primary Butyl Alcohol."—M. Lieben.—This short paper is a rather sharp reply to some remarks made by M. Linnemann upon the author's researches on this subject.

Moniteur Scientifique, No. 314, January 15, 1870.

This number contains the following original papers relating to chemistry:—

Bromide of Sodium.—M. Casthelaz.—This paper treats, at length, on the different modes of the preparation of this salt—viz., by direct action of bromine and caustic soda solution; by the decomposition of bromide of iron by means of either caustic soda or its carbonate; by double decomposition of the bromide of ammonium by caustic soda or carbonate of soda. This latter method is used on the large scale by the author, who describes in this paper the arrangements made by him to obtain a product free from chlorine, as well as from iodine.

Researches on the Yama-Mai Silk.—Dr. Bolley.—The silk alluded to is the product of a worm native of China, and feeding on oak leaves instead of on those of the mulberry tree. It appears, from this paper, that several parcels of that silk have been sent to Europe; but at Lyons, as well as at Zurich, great difficulties have been encountered in working up this silk along with, or in the same manner as the ordinary silkworm product. Several gentlemen have investigated the microscopical structure of the Yama-mai silk, and found it in almost every respect to differ from the silk hitherto generally used. The chemical composition, also, of this newly-imported substance differs; it has been found to contain, in raw state, 8·639 per cent of ash, while good raw Italian silk only contains 1·07 per cent; but, when the Yama-mai silk is first treated with some alcohol, next with dilute sulphuric acid, and then cleansed in a soap-bath, the quantity of ash is decreased to 0·59 per cent, while raw Italian silk treated in the same manner, leaves 0·95 per cent of ash. The fibroine and gummy matter of both kinds of silk have been proved identical; the colouring matter of the Yama-mai variety appears to differ from that of ordinary silk. Under perfectly identical conditions, the last-named variety of silk is more hygroscopical than the ordinary kind. Direct experiments instituted by the author have proved that the newly-imported material has a less affinity for mordants than ordinary silk, and both kinds submitted to dye-baths of the same composition and simultaneously have been proved to differ greatly as regards the colour assumed.

On Phenyl Brown, so-called Phenicienne.—MM. Bolley and Hummel.—This substance, also called *rothine*, is not to be confounded with the brown colouring matter made by Messrs. Roberts, Dale, and Co., at Manchester. The phenyl brown of M. Roth's invention is a substance which, without the use of any mordant, yields, upon silk and woollen fabrics, fast colours. Since it has

been alleged that the brown dye alluded to is possessed of explosive properties, the authors have investigated the manufacture and the reactions which take place during the process. The authors find that, when a mixture of nitric and sulphuric acids (1 part of the former of a sp. gr. of 1·35, and 2 of the latter, concentrated) are made to act upon phenol, two different products are always produced—one of these, a solid substance, sometimes like thick tar, sometimes grainy; and a deep red-coloured liquid. When this latter is poured into cold water, a pulverluent brown-coloured substance is precipitated, which possesses all the characteristic properties of commercial phénicienne. The result of the researches arrived at by the authors is that phénicienne is a compound mixture of binitro-phenol and a peculiar amorphous substance which has some likeness to the ulmic and humic substances, but the precise nature of which has not been ascertained.

Action of Shellac upon some Aniline Colours.—M. Laboureur.—When a salt of rosaniline is added to a solution of any resin, that solution is red-coloured, if the salt of aniline is soluble in the solvent used to dissolve the resin; the colour has, however, a tendency to turn violet as soon as the solution is heated or evaporated to dryness. An alcoholic solution of shellac, to which fuchsine has been added, turns, on evaporation, to a most magnificent blue colour. This material is insoluble in ether, but soluble in alcohol and acetic acid, the solutions exhibiting a blue colour. The product is, however, very unstable; and the only use this reaction could be turned to is, according to the author, the detection of shellac among other resins, since a very minute quantity of the last-named resin may by this means be detected.

Les Mondes, January 20, 1870.

Nickelising.—It appears that, as the result of researches instituted by MM. Adams, Gaiffe, and Boston, a company has been formed in America (U. S.) with the view of nickelising—*i.e.*, covering other metals, by galvano-plastic means, with a more or less thick coating of pure nickel. Since that metal is very hard, it resists, even in thin layers, rather rough usage; it is not oxidised, even in contact with water, at the ordinary temperature, and the metal assumes a brilliant polish if required. The method employed for the deposition of nickel will be fully described, since this subject was treated of at length at the meeting of the Academy of the 17th instant. The secret of the success is the use of a preparation of a very pure double sulphate of ammonia and nickel. The Company alluded to have established a branch manufactory at Paris under the management of M. Gaiffe.

Species of the Genus Equus.—M. Sanson.

January 27, 1870.

Cast-Iron Stoves.—Dr. Sacc.—The author mentions that some experiments made in his laboratory fully prove that cast-iron stoves, even if they are allowed to become red-hot, are not injurious to health, provided care be taken to insure a proper ventilation and draught in the chimney, or, rather, in the pipe leading from the stove into it. The use of cast-iron stoves, the author says, is not injurious to health, but becomes so only with imperfect draught; and that defect impairs the good use of all kinds of stoves, no matter whether they be made of cast or wrought-iron, or of any other material.

Use of Hypophosphoric Acid in Agriculture for the Purpose of Destroying Noxious Insects.—M. Martin.—The author proposes, more especially for the purpose of destroying the *Phylloxera vastatrix*, which makes great havoc in the vineyards, to apply hypophosphoric acid dissolved in water. The makers of phosphorus obtain a quantity of this acid in aqueous solution, which is thrown away as waste; but, since the transport of this waste liquid is too costly (it may be very usefully applied where it can be had with ease), the author describes a method of making hypophosphoric acid by the slow combustion of phosphorus. According to his experiments, 2 grms. of this acid dissolved in 10 or 12 litres of water, is a strong poison for all kinds of insects, and not only does not hurt plants, but has the effect of increasing the soluble phosphates in the soil.

Researches on the Improvements to be made on Galvanic Batteries.—M. Delaurier.—A lengthy paper accompanied by several engravings.

Thermo-Electrical Apparatus with Galena and Iron.—MM. Mure, Clamond, and Gaiffe.—According to the results of the experiments described at length, this apparatus deserves the attention of all who require galvanic batteries, since regularity and steadiness of action are here combined with economy and the absence of inconvenient vapours.

Zeitschrift für Chemie von Beilstein, No. 2, 1870.

This number contains the following original papers:—

Sulphotoluide.—MM. Otto and Gruber.—Sulphotoluide, as obtained when its solution in benzol is slowly evaporated, is a beautiful crystalline substance, fusing at about 156°, insoluble in water, difficultly soluble in cold alcohol and ether, and readily soluble in benzol, chloroform, and sulphide of carbon; it is soluble, without decomposition, in fuming nitrous-nitric acid, and is not acted upon when heated to 160° in sealed tubes along with a concentrated solution of caustic potassa in alcohol. Formula—

$$\begin{matrix} C_6H_4 < CH_3 \\ C_6H_4 < SO_2 \\ \qquad\quad\;\; CH_3 \end{matrix}$$

Two Isomeric Pentachlorobenzols and Bichlorobenzol-chloride.—M. Otto.—There exist, says the author, two isomeric pentachlorobenzols, C_6HCl_5. One of these is a needle-shaped, crystalline substance, not soluble in ether or alcohol, even when boiling, but soluble in benzol and chloroform, and melts at about 199°; the other substance of this name is readily soluble, even in cold alcohol, and its melting-point is 85°. Dichlorobenzol-chloride, $C_6H_4Cl_2Cl_6$, is soluble in chloroform.

A New Mode of Formation of Binitronaphthol.—Dr. Balló.—When naphthylamine is treated with nitric acid (sp. gr., 1·35), an energetic action takes place, and the result is the formation of binitronaphthol, according to the following formula:—

$$C_{10}H_7.NH_2 + 3NO_2.OH = C_{10}H_5 \cdots \left\{ \begin{matrix} (NO_2) \\ OH \end{matrix} \right\} + NO_2.ONH_4 + H_2O.$$

Bulletin de la Société Chimique de Paris, December, 1869.

This number contains the following original papers and communications:—

Studies on the Sewage-Water of Paris.—M. Chevalet.—From this paper, we learn that the portion of the sewage soluble in water (the solid muddy deposit is converted into a kind of dry manure) contains by far the larger quantity of valuable ammoniacal salts, and retains in suspension nitrogenised organic matter, which it is never possible to obtain precipitated; there remains, moreover, similar organic matter in solution. The quantity of soluble ammoniacal salts amounts to 3·371 kilos. to the cubic metre of sewage, and, in addition thereto, it contains 640 grms. of azotised organic matter.

Determination of the Molecular Groups Decomposed by an Electric Current.—M. Bourgoin.—This paper, and the following—

Electrolysis of the Organic Alkalies.—M. Bourgoin—are too lengthy to admit of any useful abstraction.

Revue des Cours Scientifiques de la France et de l'Etranger, Nos. 1 to 7, inclusive (from December 4, 1869, to January 8, 1870).

This collection does not contain, among the very valuable and interesting scientific matters embraced by it, any original paper on chemistry or sciences connected therewith. The last number, however, contains a very extensive review of a book, "Cours de Chimie Inorganique d'Après la Théorie Typique de Gerhardt, par A. Daxhelet, 2 vols. in 8vo. (Paris: Baudry).

Population of Cuba.—From this paper, we learn that the increase of the population of that island has increased to an amount second to that of the increase of the population of the United States, and excepting the latter, more than that of any other part of the world. The present population of Cuba exceeds 2,000,000 inhabitants.

The *Revue* above named contains a great many papers of interest to medical men.

No. 8, 1870.

This number does not contain any original paper relating to chemistry or allied sciences, but we meet here with an excellent physiological paper on the—

Effects of the Climbing of High Mountains upon the Human System.—M. Lortet.

No. 9, 1870.

The Astronomical Observatory at Paris.—The staff of this institution has resigned, and the Minister of Public Instruction will have to choose either to keep M. Le Verrier, and accept the resignation of the whole staff, or accept the resignation of the former, and appoint another director. It appears that very serious dissension has arisen among the parties, giving rise to daily scenes not seemly in a scientific establishment.

Annalen der Physik und Chemie, von Poggendorff, No. 12, 1869.

This number contains the following original papers:—

Thermo-Chemical Researches.—M. Thomsen.—The third instalment of a lengthy paper on this subject, containing the following sections:—Sulphuric acid; selenic acid; sulphurous acid; selenious acid; hyposulphuric acid.

Mineralogical Researches.—M. vom Rath.—The author describes, among other substances, a newly discovered mineral from the neighbourhood of Laach (Rhenish Prussia). This mineral has been named *amblystegite*. It contains, in 100 parts:—Silica, 49·8; protoxide of iron, 25·6; magnesia, 17·7; lime, 0·15; alumina, 5·05; water, 0·5. *Meteorite from Girgenti, Island of Sicily*.—It appears that of this meteorite only very small bits have been obtained in some museums. The author accidentally got a large lump which a friend sent him from Palermo, and thus an analysis became possible, giving, in 100 parts, the following results:—Chrome iron, 1·22; sulphur, 2·24; iron, 3·43; silica, 43·41; alumina, 1·57; magnesia, 26·84; lime, 1.85; protoxide of iron, 17·96; protoxide of manganese, a trace; soda, 1.50.

Crystallographical Description of the Salts derived from Sulpho-Acids of Phenol.—M. vom Rath.—Purely a crystallographical monograph.

Experiments on Dispersion Figures (Zerstreuungsbilder).—M. Bezold.

Vibrations of a Layer of Air corresponding to those of a Fixed Disc.—M. Vierth.

Reply to the Critics of M. Boltzmann.—M. Most.

Experimental Researches on the Effect Heat Exercises upon Electromotive Force.—Dr. L. Beckerode.—A lengthy monograph of great merit on a subject first investigated by Faraday.

New Sulphur Salts (Third Paper).—M. Schneider.—The author describes:—Potassiumplatinum-sulphoplatinate, obtained by fusing together 2 parts of spongy platinum, 6 of pure carbonate of potassa, and 6 of sulphur. After cooling, the mass is treated with water; what remains undissolved, exhibiting a crystalline appearance and reddish lead colour, accompanied by metallic lustre, is the salt alluded to—

$$K_2\overset{II}{S},\overset{II}{Pt}S,\overset{II}{Pt}S,\overset{IV}{Pt}S \rangle Pt\overset{IV}{S_2}.$$

Sodiumplatinum-sulphoplatinate—

$$Na_2\overset{II}{S},\overset{II}{Pt}S,\overset{II}{Pt}S,\overset{IV}{Pt}S \rangle Pt\overset{IV}{S_2}.$$

Potassiumplatinum-sulphostannate—

$$K_2\overset{II}{S},\overset{II}{Pt}S,\overset{II}{Pt}S,\overset{IV}{Pt}S \rangle Sn\overset{IV}{S_2}.$$

Sodiumplatin-sulphostannate. Disodiumplatinum-sulphoplatinate—

$$Na_2\overset{II}{S},Na_2\overset{II}{S},\overset{II}{Pt}S,\overset{IV}{Pt}S \rangle Pt\overset{IV}{S_2}.$$

Argentumplatinum-sulphoplatinate—

$$Ag_2S.Ag_2S,Pt\overset{II}{S},Pt\overset{IV}{S} \rangle Pt_2.$$

Thalliumplatinum-sulphoplatinate; this salt, obtained by a rather complex process, is insoluble in cold water; dilute hydrochloric acid extracts all the thallium, without the least evolution of sulphuretted hydrogen; formula—

$$Tl_2\overset{II}{S},Tl_2\overset{II}{S},Pt\overset{II}{S},Pt\overset{IV}{S} \rangle Pt\overset{IV}{S_2}.$$

Researches on Mica Combinations.—M. Rensch.—A purely mineralogical paper.

Comptes Rendus des Séances de l'Académie des Sciences, January 31, 1870.

This number contains the following papers relating to chemistry and sciences allied thereto:—

Observations on the Process Applied by M. Adams to Produce Deposits of Nickel on other Metals.—M. Gaiffe.—The main gist of this paper is to prove that, whatever may have been the value of the scientific experiments made on the electro-deposition of nickel upon other metals by various scientific men, none of them have succeeded in establishing an industrially-available method for the electro-deposition of nickel upon other metals; and the author states that this part of the discovery is entirely due to M. Adams.

Transformation of Octohedric Crystallised Sulphur into Insoluble Sulphur under the Influence of Light.—M. Lallemand.—It is the author says, a well-known fact, that M. Schroetter, of Vienna, proved that the action of sunlight converts ordinary phosphorus into red amorphous phosphorus. Sulphur, according to this author, is similarly affected by the direct action of sunlight, inasmuch as the sulphur, previously soluble in sulphide of carbon, and crystallisable, is converted into an amorphous modification insoluble in sulphide of carbon. The author placed a concentrated solution of sulphur in the liquid just alluded to in a sealed tube, and exposed that tube some time to the action of the sun's rays, concentrated by a lens; this causes a copious precipitation of sulphur as an amorphous insoluble matter.

Action of Magnetism upon Rarefied Gases.—M. Daniel.

Heat Evolved when Boron Combines with Chlorine and Oxygen.—MM. Troost and Hautefeuille.—According to the authors, carbon, when combining with oxygen, only gives out 8000 calorie units; boron, under the same conditions, yields 14,400 calorie units; while, when boron combines with 3 equivalents of chlorine, 104,000 calorie units represent the heat set free.

[English Edition, Vol. XXI., No. 532, pages 59, 60; No. 533, pages 69, 70.

Mode of Division of a Limited Quantity of Acid between Two Bases Applied in Excess.—M. Landrin.—The author has experimented with nitric acid and the oxides of zinc and lead; the average percentage result arrived at is—Oxide of zinc, 29·93; oxide of lead, 20·49; nitric acid, 49·58. As regards the manner of distribution of the nitric acid employed, the author finds that there exists the relation of 1 to 4—that is to say, that, for 1 equivalent of dissolved oxide of lead, there have been dissolved 4 of oxide of zinc.

Electrolysis of Oxalic Acid.—M. Bourgoin.—A lengthy paper on the electrolysis of oxalic acid. The main point of interest is that the group $C_2O_2,3HO$ suffers decomposition only.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 19, 1869.

This number contains the following original papers and communications:—

On Anthracen-Carbonic Acid.—MM. Græbe and Liebermann.—When anthracen is heated, along with liquid phosgen, in sealed tubes, no action takes place until the temperature is raised to 180°, and the full reaction is only obtained by continuous heating to 200°. The result of this operation is the formation of anthracen-carbonic acid, $C_{14}H_9.COOH$; this substance is almost insoluble in cold water, but can be obtained in crystalline state from its boiling-hot solutions in that fluid; the acid fuses at 206°, but loses some of its carbonic acid at 150°. The salts of this acid are soluble in water and alcohol; when the acid is submitted, while in solution in anhydrous acetic acid, to the oxidising action of chromic acid, anthrachinon is formed.

Synthesis of Indol.—MM. Baeyer and Emmerling.—In a lengthy paper, the authors describe the formation of indol, synthetically, from nitro-cinnamic acid, according to the following formula:

$$C_6H_4-\begin{matrix}-CH=CH-COOH\\-NO_2\end{matrix} \qquad \begin{matrix}-CH\\ \|\\ -CO_2-O_2=C_6H_4 \quad CH\\ |\\ -NH\end{matrix}$$

Azocinnamic acid, obtained by treating nitro-cinnamic acid with sodium amalgam, also yields indol when it is treated with an oxidising substance like, as for instance, peroxide of lead.

Formation of Nitro Bodies (Nitrosokoerpern).—M. Baeyer.—The author states that only such nitrogenous substances as contain the imido group, NH, are capable of yielding, with nitric acid, nitro bodies or compounds. It is further to be observed that only such imido compounds as exhibit a basic character yield nitro derivatives, and quotes, as instances, that, whereas isatine and succinimide do not yield such nitro compounds, diethylamine, diglycolamidic acid, coniine, and other substances do. The paper discusses, at length, the *modus quo* and the origin of these combinations, and the relative position of the nitro group.

Reduction of Angelic Acid to Valerianic Acid.—M. Ascher.—When angelic acid is heated to about 200°, along with hydriodic and amorphous phosphorus, for about eight hours, it is entirely thereby converted into valerianic acid, as was fully proved by the elementary organic analysis of the silver and baryta salts of the last-named acid.

Contribution to the Knowledge of Xylidine Derivatives.—M. Genz.—Starting with perfectly pure xylidine, the author prepared:—Acetxylidide—

$$C_{10}H_{12}NO=\left\{\begin{matrix}C_2H_3\\C_2H_2O\\H\end{matrix}\right\}N,$$

a solid substance, which fuses at about 113°, is readily soluble in alcohol and ether, and capable of crystallisation. Aceto-monobromxylidide—

$$C_{10}H_{12}BrNO=\left\{\begin{matrix}C_2H_3Br\\C_2H_3O\\H\end{matrix}\right\}N,$$

also a solid substance. Mexylidine, or dixylyl-guanidine—

$$C_{17}H_{21}N_3=\left\{\begin{matrix}C_{17}\\(C_8H_9)_2\\H_3\end{matrix}\right\}N_3,$$

a solid crystalline substance, difficultly soluble in water, readily soluble in alcohol and ether, combining, with chloride of platinum, to a salt—

$$2(C_{17}H_{21}N_3,HCl).PtCl_4.$$

Appendix to the Contributions on the Products of Desulphuration of Diphenyl-Sulpho-Carbamide.—Dr. A. W. Hofmann.—Too concisely written to admit of useful abstraction.

Relation of Triphenyl-Guanidine to Sulphide of Carbon.—M. Hobreecker.—

$$\underbrace{C_{19}H_{17}N_3}_{\text{Triphenyl-guanidine.}} + \underbrace{CS_2}_{\text{Sulphide of carbon.}} = \underbrace{C_{13}H_{12}N_2S}_{\text{Diphenyl-sulpho-carbamide.}} + \underbrace{C_7H_5NS}_{\text{Pheny essential oil of mustard.}}$$

The reaction proceeds further according to the following formula:—

$$C_7H_5NS+2H_2O=C_6H_7N+H_2S+CO_2.$$

Avogadro's Law, as Derived from the Mechanical Theory of Gases.—M. Naumann.—An algebraico-chemical essay.

On Chloro-Phenol-Sulpho Acid.—M. R. Bähr Predari.—The author describes, at great length, several compounds obtained by him; the chief substance is a potassium salt, $C_6H_4ClKSO_4+2H_2O$, losing, at 110°, its water of crystallisation, fusing at 245°, and becoming decomposed at 300°.

Determination of the Mineralogical Formula of some Mixed Rhombohedrical Carbonates.—M. Cossa.—This paper treats on the question whether, in such substances as dolomite, mesitine, and others, the carbonates of lime and magnesia, and of protoxide of iron and magnesia, are simply mixed or are chemically combined. The paper, however interesting in many respects, is too lengthy and too full of formulæ for useful abstraction.

Incorrectness of the Thermo-Chemical Estimations and Researches made, by means of the Mercurial Calorimeter, by MM. Favre and Silbermann.—M. Thomsen.—Chiefly a series of tabulated formulæ and figures.

Methods of Distinguishing Molecular Compounds.—M. Rathke.

Molecular Weight of some Protoxide Combinations.—M. Ladenburg.

Third Paper containing the Results of the Researches on the Ethereal Derivatives of Acids and Alcohols.—M. Henry.—Among a series of different products, the author describes, chiefly, monochloro-methylphenol, $C_6H_4Cl(CH_3O)$, a very mobile fluid, insoluble in water and in caustic alkaline liquids; soluble in alcohol and ether; sp. gr. at 0°, 1·182; boiling-point 200°. Monochlorethylphenol, $C_6H_4Cl(C_2H_5O)$, also a liquid, boiling at 210°; sp. gr. at 0°, 1·106. Monobromo-methyl-phenol, $C_6H_4Br(CH_3O)$, a liquid boiling at 220°; sp. gr. at 0°, 1·494.

Some Reactions of Anhydrous Sulphuric Acid, and a New Method of Formation of Oxysulphide of Carbon.—M. Armstrong.—After referring to the labors of MM. Schützenberger, Rose, and Williamson on this subject, the author describes a series of experiments made with anhydrous sulphuric acid and sulphide of carbon, equivalent parts of which substances having been mixed and heated on a water-bath, give rise to the formation of oxysulphide of carbon and sulphur, according to the following formula:—

$$CS_2+SO_3=COS+SO_2+S.$$

[English Edition, Vol. XXI., No. 533, page 70.]

Specific Heat of Gases, and the Correct Capacity for Heat.—M. Horstmann.—An algebraico-physical monograph.

Neues Jahrbuch für Pharmacie, von Dr. F. Vorwerk, November and December, 1869.

These two papers, published together, contain the following original papers and memoirs:—

Detection and Estimation of Arsenic in the Rosaniline (Fuchsine) of Commerce.—Dr. Riecker.—This very lengthy paper is essentially devoted to the testing of the correctness of the methods for the quantitative estimation of arsenic, and the possibility of the quantitative estimation of arsenious and arsenic acid separately, when both these substances are present. As regards the qualitative detection of arsenic in fuchsine, the author states that the pigments of that name tested by him, and obtained from various sources, all contain arsenic in some form or other. That this quantity is not small may be inferred from the results of the author's quantitative analysis, from which we gather that a sample of fuchsine obtained direct from a manufacturer contained, on an average, 2·073 per cent. of arsenious acid and 7·593 per cent. of arsenic acid. Another sample, obtained from a wholesale drysaltery, contained, on an average (several analyses were made), 1·608 per cent. of arsenious acid and 4·4705 of arsenic acid. This research was undertaken with the express view of testing the question, whether the use of fuchsine, as a coloring matter for syrups, sweetmeats, and the like, is or is not to be prohibited, as can be done in Prussia by a simple police order. It is quite evident that fuchsine should not be indiscriminately used for such purposes.

Easy Method of Removing Gypsum from Water.—Dr. Riecker.—The use of witherite, native carbonate of baryta, is recommended by the author to remove all the gypsum from water. Of course the quantity of the mineral to be applied for this purpose should be regulated according to the quantity of gypsum present in the water; but, as an instance, we may state that a water containing, in 10,000 parts, 4·37 parts of gypsum, requires about ½ lb. of witherite, ground to a fine powder, for every large pailful of that water. After the addition of the witherite, the water is well stirred, and next left at rest to deposit the sediment for twenty-four hours, and then run off for use. The water may be either boiled before or after this process, and will be found quite soft.

Proper Arrangements of Pumps so as to Yield a Pure and Wholesome Potable Water.—Dr. Riecker.—Attent on is called to the necessity of excluding from pumps any surface, or drainage, or sewage waters, and to bore the wells to such a depth as to be out of the reach of such contaminations of the water to be used for domestic and industrial purposes.

Cosmos, February 5, 1870.

Investigation of the Grotto of Montesquieu-Avantès (Ariège, France).—M. Regnault.—The researches made by this author of the locality alluded to, lead him to agree with MM. Vogt, Broca, Strenstrup, and other *savants*, as to the anthropophagic nature of primeval man.

Atmospheric Electricity of Haiti.—M. Ackermann.—The island of St. Domingo, as it is also called, is situated between 17° 53' and 19° 58' N. latitude, and between 70° 45' and 76° 55' latitude W. from Paris. According to the author, who has, during a series of five years, made meteorological observations at Port au Prince, there have, on an average, been 129 days of each year either severe thunderstorms, or other very marked electrical phenomena, especially during the months of May, July, August, and September. Severe thunderstorms more frequently occur during day- than night-time. The year 1868 was especially remarkable for severe thunderstorms; during one of these, lasting for forty-five minutes, 400 lightning flashes were distinctly seen.

Pharmaceutische Zeitschrift für Russland, November, 1869.

This number contains the following original papers and memoirs relating to chemistry:—

Monograph on Inuline.—Dr. Dragendorff.—Continued from former numbers. This exhaustive paper is not yet ended.

Preparation of the Amides of Polybasic Acids.—Dr. Losch.—The author prepared tartramide, citramide, and succinamide, by causing liquid ammonia to act upon the ethers of the acids referred to. The chief result of the author's researches on this subject is that, by the action of liquid ammonia (in aqueous solution), just alluded to, the neutral amides of the acids are only formed for a moment; but decomposition sets in, and other compounds result from the reaction, and it is, therefore, necessary to act upon the ethers referred to with an alcoholic solution of ammonia-gas when it is desired to obtain the amides of the acids.

Artificial Kirschwasser.—M. Reinsch.—The genuine alcoholic fluid of this name owes its flavour to the presence of a small quantity of hydrocyanic acid and ethereal oil of bitter almonds (hydruret of benzoyl). The author suggests that, when a certain quantity of the young leaves of the peach tree (a handful is named) is beaten up in a porcelain mortar, next digested with 4 litres of water during two days, and this mixture added to 2 litres of strong alcohol (94 per cent), and submitted to distillation, and the distillate diluted with water to a strength of 60 per cent alcohol, a fluid is obtained fully equal in taste and aroma to the best Swiss kirschwasser made from cherries bruised up with the stones and kernels they contain. The author cautions against the drinking of too large quantities of this liquor; and so he may, since cases of accidental poisoning with this and similar alcoholic liquors (Persico among the number) are by no means rare.

Moniteur Scientifique, No. 315, February 1, 1870.

This number contains the following original papers relating to chemistry and subjects allied thereto:—

Direct Application of Wool-Suint (Fatty Matter containing a large quantity of Potassa Salts) to the Preparation of Prussiates and Cyanides.—M. Havrez.—Suint contains some 40 per cent of potassa; and, when previously ignited, this alkali becomes thereby intimately mixed with strongly-nitrogenised animal charcoal. The author chiefly points out the profit to be derived from the use of suint for the manufacture of prussiates and cyanides, and to the paper is added a short report from M. Schattenmann, prussiate and cyanide manufacturer, at Bonxwiller, near Strasburg, who states that results of experiments made with suint by him, on the large scale, are decidedly favourable to the use of that substance for the purpose alluded to. It should be observed that the quantity of suint contained in raw wool amounts to one-third of its weight; and the author states, in a foot-note, that, since in 1867 there was imported into the United Kingdom 63,000,000 of raw wool from the Cape and Australia, the quantity of suint contained therein amounted to at least 20,000,000 kilos.

Latent Heat of Volatilisation of Liquids.—M. Koehler.—An algebraico-physical treatise.

Artificial Alizarine.—M. Kopp.—The author points out that there are at present several processes of preparation of alizarine by artificial means, which are entirely different from each other. After mentioning MM. Græbe and Liebermann, and Gutzkow and Broenner, the author

states that Dr. Grieff, at Cologne, has just come forward with an entirely new process, which will be tried on the large scale by MM. Weiler and Co., of that city. Reference is made to the fact that the purified alizarine (artificially made by MM. Meister and Lucius) yields, on elementary analysis, in 100 parts—Carbon, 60·92; hydrogen, 3·34; oxygen, 26·74. The formula $C_{14}H_8O_4$, by some assigned to alizarine, requires, percentically—C, 70·00; H, 3·33; O, 26·67. The author enters, at some length, into the question, whether artificially-made alizarine, even if it be cheaply and abundantly produced, will prove, in all respects, a suitable substitute for madder, and comes to the conclusion, for good and sound reasons (too many to quote here, but which we fully endorse), that the very composition of madder is such as to ensure its continued use, and even preference above any of its single tinctorial elements, because the effects produced by madder and its commercial preparations are due to the joint action of all its tinctorial and some one or more of its other constituents.

Soluble Iodine Green.—MM. Kalle and Co. write from Biebrich, Nassau, Prussia, stating that they have succeeded in producing an iodine green soluble in tepid, and even cold water, without difficulty. This new material, moreover, does not contain picric acid, and, being less acid, does not require silicate of soda, for which borax is to be substituted. This dye yields so fast a colour that woollen tissues can be fulled after dyeing with it.

Polytechnisches Journal von Dingler, first number for December, 1869.

This number contains the following original papers relating to chemistry and allied sciences:—

Experiments made with the view to Determine Percentically the Value of Fire-Clays.—Dr. Bischoff.—In a lengthy paper, the author records a series of pyrometric experiments made with the view of ascertaining the value of such substances as pure silica, alumina, and mixtures of the same, in respect to resistance of fusion, and, also, of various native mineral products, known by different names and of very different mineralogical and chemical characters.

Second number for December, 1869.

Preparation of Ferricyanide of Potassium, or Red Prussiate.—M. Reichardt.—The author recommends the use of bromine, instead of the usual application of chlorine, to convert the ferrocyanide of potassium (yellow prussiate) into ferricyanide. 422·28 grms. of crystallised ferrocyanide require 79·97 = 80 of bromine = 100 : 19 = *circa* 6·33 c.c. The formula is—

$$2(2KCy + FeCy + 3HO) + Br = 3KCy + Fe_2Cy_2 + KBr.$$

Experiments made, on the small scale, with 50 grms. of ferrocyanide, proved that 9·5 grms. of bromine were required; and the operation is very rapidly finished. The author states that experiments made on the large scale answer exceedingly well.

Chemical Analysis of a Sample of Extract of Meat.—M. Reichardt.—This sample was prepared by a private firm, and yielded, on analysis, the following results:—Portion soluble in alcohol (of 83 per cent strength), 80·76 per cent; water, 16 per cent; fatty matter, 0·2 per nitrogen, 9·99 per cent; ash, 21·36 per cent (containing potassa, 9·0 per cent; soda, 2·3 per cent; phosphoric acid, 6·1 per cent. These results, as compared with Liebig's and the Fray Bentos extracts, are stated by the author to be in favour of the extract tested by him for MM. Buschenthal and Co.

First January number, 1870.

Substances Suitable to Agglutinate Coal-Dust.—M. Jicinsky.—This paper is a valuable contribution to the proper methods of utilising coal- and coke-dust and small coals, and the manufacture of artificial fuel, but cannot be understood without reproduction of the engravings.

Analysis of Pig-Iron.—M. Richter.—The sample was obtained from a peculiar iron ore met with in Silesia. The sp. gr of the iron = 7·361. It contained in 100 parts:—Iron, 90·041; copper, 5·343; cobalt, 0·666; nickel, a trace; arsenic, 0·013; silicium, 1·644; phosphorus, 1·464; sulphur, 0·404; combined carbon, 0·723; no molybdenum.

Revue Hebdomadaire de Chimie, January 20, 1870.

Analysis of Some Extracts of Meat as met with in Commerce.—M. Lebaique.—The number above quoted contains the results which we reproduce here; but a full account of the method of analysis employed is recorded in two previous numbers—viz., those of December 23rd and 30th. The author distinguishes the extracts by the figures A, B, C, D, and E, referring, respectively, to—Liebig's meat extract; La Plata extract; extract from M. Tooth, Sydney; extract of French Company in South America; extract of M. Whitehead, Sydney. Organoleptic, or physical properties of the extracts:—A. A firm, homogeneous, yellow-coloured substance, perfectly soluble in water, yielding a brown-coloured solution, and exhibiting a strongly-pronounced smell as well as taste, contains 7·5 per cent of water, 61·2 per cent of substances soluble in alcohol, 23 per cent of ash, and a total of 9 per cent of nitrogen.—B. (Two samples.) No. 1 is a somewhat soft, homogeneous, brown-coloured substance, imperfectly soluble in water (insoluble residue amounts to 2·5 per cent); the aqueous solution is brown-coloured, and exhibits a strong animalised smell and taste; it contains 9·0 per cent of water, 53 per cent soluble in alcohol, 21 per cent of ash, and a total of 9 per cent of nitrogen. No. 2 is a soft, brown coloured, homogeneous substance, soluble in water, without residue, brown-coloured solution, odour and taste rather strong; it contains 16 per cent of water, 53 per cent soluble in alcohol, 18 per cent of ash, and a total of 9·6 per cent of nitrogen.—C. A soft, light brown-coloured, non-homogeneous substance, only imperfectly soluble in water (insoluble residue, 3 per cent); the aqueous solution is light brown-coloured, and odour and taste are rather strong; it contains 15 per cent of water, 54 per cent soluble in alcohol, 21 per cent of ash, and a total of 8·4 per cent of nitrogen.—D. A hard brown-coloured granulous substance, imperfectly soluble in water (1·5 per cent of insoluble residue); colour of aqueous solution, bright brown; taste and odour less strongly marked than that of the other samples; it contains 16·5 per cent of water, 28 per cent of matters soluble in alcohol, 9·5 per cent of ash, and a total of 10·7 per cent of nitrogen.—E. A soft, homogeneous, light brown-coloured substance, soluble in water without leaving any residue; colour of solution brown; smell and taste rather strong; it contains 17 per cent of water, 47 per cent of matter soluble in alcohol, 19 per cent of ash, and a total of 9·46 per cent of nitrogen. The alcohol applied contained 90 per cent of absolute alcohol.

Chemical Investigation of the Apples suitable for Cyder Making.—M. Mene.—It appears that there has been held, at St. Lô (Brittany, France), a mixed congress, of scientific men and agriculturists, who have investigated this subject. The method of analysis, and the divers means employed to ascertain the following particulars, viz., sp. gr. of the juice, dry glucose, dry mucilage, tannin, free malic acid, divers malates, and water, are given at great length; and a tabulated form records the results obtained by the analysis of some twenty-four kinds of apples, stating the constituents for 1000 parts. The lowest sp. gr. of the juice has been found at 6·5, the highest at 11·7; smallest quantity of glucose, 122·0, highest, 194·0, for 1000 parts.

New Reagent for the Estimation of Carbonic Acid in Combination in Bicarbonates and in Natural Waters.—M. Lory.—The author employs phosphate of copper dissolved in a very slight excess of hydrochloric

acid: the phosphate of copper is obtained by precipitating a solution of bichloride of copper with ordinary phosphate of soda. The precipitate is collected on a filter, well washed, and, after having been taken from the filter, suspended in water and dissolved by the addition of a few drops of hydrochloric acid. When this reagent is added to any water containing alkalies or alkaline earths in the state of carbonates or bicarbonates, the result is, at first, the formation of a bluish coloured cloudiness, or turbidity; by the addition of a larger quantity of this reagent, this turbidity disappears, and the liquid becomes clear again. This point having been reached, the quantity of the reagent applied will be proportional to the total equivalent of the bases present, and, consequently, to the carbonic acid which was combined with these bases. In order to titrate the reagent, dissolve 0·265 grm. (equal to 1-200th equivalent) of perfectly pure and dry carbonate of soda in water, and saturate this solution with carbonic acid, in order to convert it into bicarbonate (excess of carbonic acid does not at all affect the reagent). 4·4 c.c. of this solution upon 1 decilitre of pure water should produce, by the addition of the copper liquor, the reaction already alluded to, and these 4·4 c.c. correspond to 0·220 grm. of carbonic acid.

January 27, 1870.

Manufacture of Hyposulphite of Soda with Alkali Waste.—M. Mène.—Sulphate of soda is added to the alkali waste, which is spread out in regularly-formed heaps, or beds, and this mixture is left to the action of atmospheric air; the soda salt alluded to is decomposed, and there is formed a large quantity of hyposulphite, which makes its appearance in the shape of efflorescences. When this has increased to a certain point, the mass is treated with water, and the aqueous solution is next treated with a weak acid, in order thereby to eliminate salts of lime and some sulphides. This latter operation also produces sulphur, since the sulphuretted hydrogen which is given off may be utilised.

Useful Application of Mica.—M. Mène.—In Germany, the doors of the steam-boiler furnaces are now very generally provided with square pieces of mica, properly fastened, by means of which the fireman is enabled to observe the fires without the necessity of opening the furnace doors too frequently, which is injurious, on account of interfering with the draft and proper course of combustion of the fuel, by reason of the access of irregular currents of cold air. Mica withstands a very high temperature, and the accidental breakage of these squares, or panes of this substance thus inserted is guarded against by a properly-constructed iron wire-guard outside.

Electrical Pyrometer.—M. Becquerel.—Without reproduction of the cuts, this paper is not available for abstraction.

Les Mondes, February 3, 1870.

Artificial Caoutchouc.—M. Granier.—This material is a mixture containing gelatine and a variety of other substances (not specified) producing a homogeneous elastic substance, insoluble in mineral, as well as vegetable essential oils; not acted upon, moreover, by either coal or other hydrogenised gases. This material is now employed in France for a variety of purposes, too many to be here enumerated; its cost is only 3 francs per kilo.; and it melts readily at 100°, without decomposition, and can be cast into different moulds. Neither cold nor heat affect this substance, which, when completely oxidised, becomes more infusible than vulcanised caoutchouc.

Crystallisation of Diamond, Rock-Crystal, and Tribasic Phosphate of Lime by means of Cold.—M. Collas.—The author begins his paper with the following statement:—"The last of the subjects just mentioned is an accomplished fact; the second (speaking of rock-crystal) has been only half attained; and the first is, as yet, a hypothesis." The gist of the paper, which contains a lengthy description of experiments, may be summarised as follows:—The hydrate of the basic phosphate of lime becomes horny by desiccation, pulverulent on being boiled, and crystalline by congelation. The precious-stones, which contain cavities filled with a liquid, are crystallized hydrates, and the liquid alluded to is a remnant of the water of the hydrate. A hydrate crystallises in a manner different from that of the crystallisation of a saturated saline solution. The crystallisation of a hydrate by cold (freezing) is a dissociation; the hydrated substance precipitates entirely in crystalline state. Lastly, the author states that it is a contradiction, so to say, to try to obtain crystallised carbon (diamond) by means of heat. The author's opinion concerning this crystalline carbon is that, at a very remote period of the existence of our globe, hailstorms of diamonds have taken place. And to the paper a map is added indicating, by means of a curved line, the *cercle diamantaire*—*i.e.* the area within which diamonds are now to be found. Graphite is, according to the author, destroyed diamond—that is to say, diamond which has lost its crystalline state.

Pre-Historic Man.—M. Capellini—The author has explored a grotto in the island of Galmeria, Italy, and found human and animal bones, mixed up with flint instruments, and several objects undoubtedly made by men. This grotto is so situated as to make its exploration not only difficult, but dangerous; yet it appears, according to the author, to have been inhabited, since traces of a fire-place were discovered therein.

Comptes Rendus des Séances de l'Académie des Sciences, February 6, 1870.

This number opens with a brief communication on a subject which, though not belonging to chemistry, we cannot refrain from quoting, viz.:—

Extraordinary Fall of Snow at Collioure, Pyrenees Orientales, France.—Ch. Naudin.—Collioure is situated on the Mediterranean, in latitude 42° 32 N. The author states that the prevailing temperature, up to the 17th of January, had, as usual, ranged from +11° to +17°C.; it then fell gradually, and on the 21st ult., while at −0·8°, a fall of snow commenced, which continued for 44 consecutive hours. A few of the oldest inhabitants remember a similar phenomenon taking place in the year 1804; very few, however, have ever witnessed such a remarkable occurrence. The average depth of the snow amounted, in open spaces, to from 80 to 120 centims., but in some parts it accumulated to a depth of nearly 1·5 metres (fully 5 ft.); the temperature at this time was about −1°. Among the very noticeable points, the author speaks of the palm trees, which were literally flattened down, as plants are in an herbarium; but, curiously enough, notwithstanding some of them have been for ten or twelve days in a mass of ice and snow, they have suffered very little, compared with the orange, lemon, and olive trees, most of which are destroyed. The author, therefore, calls particular attention to this fact, because geologists have drawn conclusions as to climate from the discovery of palm trees in the miocene strata; and it appears to him that the facts observed at Collioure prove (though isolated) that these plants might actually stand a severer winter climate than is usually believed, while they also point out that the causes of the death of plants in winter are more complex, and not simply due to a certain degree of cold only.

Proof of the Destruction of the Chemical Type when Substitution Takes Place.—E. J. Maumene.—This lengthy paper is chiefly devoted to prove a peculiar theory which the author holds. The paper is too lengthy for useful abstraction.

On Thermo-Electricity.—J. Delaurier.—The author says—"I have proved the existence of metals and other bodies which are by themselves thermo-electric, and these

I call active bodies. The production of electricity is not due to the two metals which are soldered or joined together, since a non-active metal is only a carrier of the electricity developed by heat in the active body. The cause and direction of the current depend chiefly upon the molecular structure of the active body. Heat is converted into electricity by preference in those substances which are relatively better conductors of electricity than of heat. There exist solid bodies which possess the property of yielding as much electricity as hydro-electric elements; among these, tellurium and iron pyrites stand foremost."

Observations on the Zodiacal Light and Aurora Borealis at Munster, Westphalia (Prussia).—M. Heis.

Simplification of the Construction of Holtz's Electrical Machine, and Determination of the Relation between the Dynamical Work Done and the Quantity of Electricity Produced.—E. Bouchotte.—A lengthy memoir on this subject.

Heat Evolved when Silicium Combines with Chlorine and with Oxygen.—L. Troost and P. Hautefeuille.—This paper is a continuation of one on the same subject, by the same authors. In this very lengthy memoir amorphous silicium is treated. The heat disengaged by the combination of 1 grm. of this amorphous body with oxygen is 7830 units; with chlorine, 5630. When 1 grm. of chloride of silicium reacts upon 140 times its weight of water, it is 2915; the heat disengaged when 1 grm. of amorphous silicium is converted into crystallised silicium is 290 units of heat. When taken by equivalents, these quantities become, respectively:—

	For Si = 14.	For Si = 21.
With oxygen	109,620	164,430
With chlorine	78,820	118,230
When the chloride reacts upon 140 times its weight of water	40,820	61,220
When conversion from amorphous to crystallised	4,060	6,090

There is added to this paper a very interesting, but, unfortunately, too lengthy discussion on certain phenomena observed in the Bessemer and other metallurgical processes of iron manufacture.

New Method of Synthesis of Organic Acids.—M. Berthelot.—Reserved for full translation.

Simultaneous Formation of Isomeric Substances in Definite Proportions.—A. Rosenstiehl.—The author refers to his former researches on this subject, and treats, in this memoir, a rather intricate matter, the main gist of which is, that not (as has been stated by several chemists) three, but only two, isomeric toluens are formed when nitric acid acts upon the toluen obtained from coal-tar.

Nature and Origin of the Blood Globules.—MM. A. Béchamp and A. Estor.

Present State of the Volcano of Santorin.—M. Gorceix.

Presentation of Valuable Manuscripts.—M. Bontemps.—This gentleman has handed over to the Academy the very valuable collection of manuscripts left by the late Prof. Charles, whose name is connected with the first experiments of the use of hydrogen, in the year 1783, for the purpose of filling air balloons. The deceased was, in his day, a physicist of celebrity; and his lectures on experimental natural philosophy are well known. The Academy has accepted the offer made by M. Bontemps, who had obtained these papers in consequence of his father having been Prof. Charles's friend and one of the executors of his will.

Journal de Pharmacie et de Chimie, January, 1870.

This number contains the following original papers relating to chemistry:—

Transformation of the Hydrate of Chloral into Chloroform in the Animal Body.—M. Personne.—A physiologico-chemical essay.

Researches on the Electrolysis of Organic Alkalies, or Alkaloids.—M. Bourgoin.—The author, in order to illustrate his subject, begins by explaining the action of an electric current upon perfectly pure and neutral sulphate of ammonia—

$$SO_2NH_4O = \underbrace{(SO_3+O)}_{\text{Positive electrode.}} + \underbrace{(NH_4)}_{\text{Negative electrode.}};$$

and next at the positive electrode, $(SO_3+O)+3HO=SO_2\ 3HO+O$, and at the negative electrode, $NH_4=NH_3+H$. The author next describes, at length, a series of experiments made with neutral sulphate of atropine, the acid sulphate of atropine, neutral sulphate of brucine, the acid sulphate of brucine, and the neutral and acid sulphates of codeine and quinine. The conclusions to be drawn from these experiments may be summarised as follows:—The electric current decomposes the salts of alkaloids in the same manner as it acts upon sulphate of ammonia—that is to say, the basic element reconstructs the alkali at the negative electrode, and the rest of the elements of the salt is set free at the positive electrode. When the solution is acid (not readily so when it is neutral), the positive liquid assumes a colouration which is precisely the same as that which nitric acid yields, but is entirely independent of the formation of any nitrated compound. The gas given off at the positive electrode contains not only oxygen, but also carbonic acid and oxide of carbon, often in equal bulks. There are, beside these gases, various other products formed (especially ammoniacal compounds)—the result of the splitting up of the alkalies which are gradually burnt up by the action of the oxygen, which action is the more energetic the more acid the solution contains.

Researches on Bromide of Potassium: its Best Preparation and Composition when Pure.—M. Adrian.—This paper contains the results of analyses of ten samples of bromide of potassium, from which we condense the following points:—The quantity of water interposed (water of decrepitation) between the crystals varied from 4 to 0·5 per cent; the quantity of free, or carbonated alkali, not combined with the haloid, varied from 4 to 1·5 per cent; the quantity of iodide of potassium (contained only in three out of the ten samples), varied from 2 to 0·5 per cent; the quantity of bromide of potassium varied from 91·60 to 62·80 per cent (average of ten samples, 83·67 per cent); chloride of potassium varied from 3·5 to 30·07 per cent; sulphate of potassa varied from 0·90 to 3·30 per cent; while, of bromate of potassa, traces were present in all, and an appreciable quantity in one sample.

On Mustard.—M. Commaille.—A lengthy memoir, compiling what is known of the chemical constitution and properties of mustard, and its pharmaceutical uses.

Annalen der Chemie und Pharmacie, January, 1870.

This number contains the following original papers and memoirs:—

On Fermentation, and on the Source of Muscular Force.—Dr. Justus von Liebig.—This paper is the first instalment of a series to be continued. The section title to this memoir is "Alcoholic Fermentation:" we regret that it is not possible here to enter into any details of this memoir, which deserves full translation.

Contribution to our Knowledge of the Bases Contained in Opium.—M. Hesse.—After referring to the labours of M. Merk, and his own former researches on this subject, the author describes meconidine, lanthopine, and laudanine. Meconidine, $C_{21}H_{22}NO_4$, is a rather readily decomposable compound in the presence of strong acids, and especially when heat is simultaneously applied; this

base yields salts with difficulty, and these compounds are very unstable. Laudanine is readily soluble in benzol and chloroform, also in boiling alcohol, but difficultly soluble in ether and alcohol when cold; this base, although tasteless by itself, yields, with acids, very bitter salts; fuses at 165°; formula, $C_{20}H_{25}NO_3$; yields salts with acids, well-defined chemical compounds. Lanthopine, $C_{23}H_{25}NO_4$; this substance is best soluble in chloroform, difficultly so in alcohol, ether, and benzol; it yields, with acids, salts. Thebenine, $C_{19}H_{23}ClO_6$ (formula of the hydrochlorate of this base), is an amorphous substance, and rather prone to decomposition.

Treatise on the Urea Compounds.—M. Menschutkin.—First part: The Ureides. Section 1: Action of Cyanate of Potassa upon the Amide Acids, and the Derivatives therefrom.—Oxybenzuramic acid—

$$C_6H_4[NH(CO.H_2N)].CO_2H;$$

oxybenzoyl-urea—

$$C_6H_4[N(CO.H_2N)].CO;$$

oxybenzuramide—

$$C_6H_4[NH(CO.H_2N)].CO.H_2N;$$

anisuramic acid—

$$C_6H_3[NH(CO.H_2N)].CH_3O).CO_2H.$$

Space forbids us to quote more formulæ, with which the treatise abounds.

On Dichlorobromohydrine, and its Decomposition by Hydrate of Baryta.—M. Claus.—The main object of this paper is the vindication of the correctness of the author's labors on the subject, somewhat impugned by other labourers in the same field.

Some of the Combinations of the Toluol Group.—MM. Limpricht and Schwanert.—Second paper on this subject, treating chiefly of:—Oxytoliden, $C_{14}H_{10}O_2$, solid substances, readily soluble in ether and boiling alcohol, fusing at 172°, and subliming without decomposition; bromoxytoliden, $C_{14}H_9BrO_2$, an oily fluid; bibromoxytoliden, $C_{14}H_8Br_2O_2$, a solid substance, soluble in ether, sulphide of carbon, and boiling alcohol; chloroxytoliden, $C_{14}H_9ClO_2$, a solid crystalline body, soluble in ether, benzol, and boiling alcohol, also in glacial acetic acid, and fusing at 57°; trichloroxytoliden, $C_{14}H_7Cl_3O_2$, a solid body, fusing at 87°, and soluble in benzol, ether, hot alcohol, and hot glacial acetic acid; pentachloroxytoliden, $C_{14}H_5Cl_5O_2$, readily soluble in benzol and boiling glacial acetic acid, difficultly soluble in ether and alcohol, and fusing at about 189°.

Preparation of Lepiden from Thionessal.—M. Berlin.—The author heated thionessal with HCl and chlorate of potassa, and the purified product of this reaction was again heated in a sealed tube with hydriodic acid, to 140°; the resulting product gave, after purifying and recrystallisation, lepiden, $C_{16}H_{10}O$.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, No. 204, December, 1869.

This number contains the following original papers relating to chemistry and allied sciences:—

We briefly call attention to two reports, the subjects of which, although not related to chemistry, deserve a passing notice:—

Report on a Printing Stenographic Apparatus Invented by M. Bryois.

Report on the Means of Saving Life in Cases of Fire in Dwelling-Houses and High Buildings.—M. Charrière.—This excellent report is illustrated with woodcuts, and deserves the attention of all whose dwelling-houses and places of abode are at some elevation above the level of the streets.

Alkaline Lakes of California.—M. Phillips.—It appears that a portion of California is very rich in mineral waters, and, moreover, contains large sheets of water, evidently occupying the craters of extinct volcanoes. The water of Lake Owen has a sp. gr. of 1·076, and contains 7128·24 grs. of solid matter to the gallon, consisting of 2942 grs. of chloride of sodium, 956 grs. of sulphate of soda, and 2914 grs. of carbonate of soda; while the rest is composed of sulphate and phosphate of potassa, silica, and traces of organic matter. On the banks of this lake, an incrustation occurs, of yellowish white color; this substance gave, on analysis, in 100 parts—Chloride of sodium, 2·14; sulphate of soda, 3·10; carbonate of soda, 46·10; silica, 0·22; traces of potassa; and 48·44 of water and organic matter. The Kaysa, or borax lake, yields, daily, 3000 lbs. of crude borax, composed, in 100 parts, of—Dry biborate of soda, 51·85; water of crystallisation, 45·44; insoluble matter, 1·42; dry sulphate of soda, 0·05; chloride of sodium, 0·08; phosphate of soda, 1·15. The water of this lake has a sp. gr. of 1·0274, and contains, of the following substances, the quantities thereby quoted in grains to the imperial gallon:—Chloride of sodium, 1198·66; chloride of potassium, 9·92; iodide of magnesium, 0·22; bromide of magnesium, a trace; carbonate of soda, 578·65; biborate of soda, 281·48; phosphate of alumina, 3·52; sulphate of lime, traces; silica, 2·37; matters volatile at red heat, 238·66. All the salts are calculated in the anhydrous state. The mud of this lake contains large quantities of crystallised borax; at some short distance from this lake, a rich sulphur deposit is met with, which contains, also, a vein of cinnabar; both these minerals are now worked. The quantity of sulphur daily obtained amounts to some 7 tons' weight.

Mining, and some other Industries of Russia.—This empire contains 1043 gold mines, which, in 1866, produced 26·5 tons of pure gold; only 18 tons of silver were produced; the quantity of platinum was 1712 kilos.; and of copper, 4320 tons were obtained. The 262 beet-root sugar works produced, in 1867, 70,000,000 kilos. of sugar; while, during the same period, 382,000 metrical quintals of tobacco were grown.

Official Instruction concerning the Keeping and Use of Nitroglycerine.—The Chief Inspector of Mines at Dortmundt, Prussia, while sanctioning the use of this material for blasting purposes, has laid down excellent rules for its safe keeping and management, which deserve attention, and may be usefully applied wherever this explosive substance is employed.

Jahrbuch der Kaiserlich-Königlichen Geologischen Reichsanstalt, No. 3, 1869.

Among the record of the labours performed at the Chemical Laboratory of this Institution, we meet with a lengthy series of minute analyses of braunkohlen. Kaolin from Budweis—Silica, 48·6; alumina, 43·0; peroxide of iron and magnesia, a trace; water, 8·2. Fire-clay from Biharer (Hungary)—Silica, 60·3; alumina, 28·0; lime, 0·5; water, 10·5. Porcelain clay from Mahrenberg (Styria) Silicate of alumina, 87·6; alumina soluble in HCl, 5·5; magnesia, 2·1; water, 4·6. Iron ore from the Josephsthal iron ore quarries—Insoluble in HCl, chiefly quartz, 61·8; peroxide of iron, 30·5; lime, 8·0; magnesia, a trace; yield of metallic iron, 21·3 per cent. Crude carbonate of potassa from Czernowitz—Insoluble in water, 0·1; carbonate of potassa, 58·0; carbonate of soda, 2·1; sulphate of potassa, 14·2; chloride of potassium, 3·1; water, 23·2. The Director of this Laboratory, Dr. Karl Ritter von Hauer, states that the water was taken up hygroscopically.

Les Mondes, February 10, 1870.

This number opens with a lengthy paper on the—

Imperial Observatory.—M. Moigno.—The main gist and aim of this paper is a review of M. Le Verrier's career

as Director of the Observatory, a situation from which that gentleman has been relieved by a recent imperial decree.

Artificial Construction of Mineral Springs.—M. Rouby.—There is a woodcut annexed to this paper which renders its proper understanding an easy matter. The affair is, however, simple enough, since the contrivance (applicable only in the country, and requiring, moreover, a hilly region) consists of a subterranean water-tight tank, covered on the top with divers layers of minerals, through which the rain-water is made to pass; and this, while trickling down, dissolves a portion of the mineral matters, and enters, thus charged therewith, the tank, from which an exit-pipe leads it to the place of consumption.

Solar Electricity.—M. Marco.

Syphon Pumps and Suction Syphon.—M. Lagillardais.—A good paper on applied hydrodynamics, illustrated by woodcuts.

Improved Photometer for taking Positive Carbon Proofs.—M. Marion.—Illustrated by a cut.

Labour of Children in Manufactories.—Dr. Decaisne.—An interesting account of a large establishment at Lyon.

Annales de Chimie et de Physique, December, 1869.

The only original paper contained in this number is a brief optico-physical description of a—

New Micrometer.—M. Soleil.—Not suitable for abstraction.

Revue des Cours Scientifiques de la France et de l'Etranger, No. 16, 1870.

Contains nothing relating to chemistry or allied sciences

February 12, 1870.

Banquet to Dr. A. W. Hofmann at Berlin.—The German Chemical Society, having elected Dr. Rammelsberg as their President for this year, have entertained their late President, Dr. A. W. Hofmann, at a splendid and sumptuous banquet, presided over by Prof. Magnus. Among the large number of guests, we name Dr. R. Virchow, Prof. Dove, Prof. Rose, Dr. du Bois Reymond, His Excellency the Right Hon. Mr. Bancroft, the United States Minister at Berlin, and a very large number of *savants* from Berlin and other parts of Germany. Many of the foreign members' sent telegrams of felicitation, and among these the following was received from M. J. Dumas, Paris:—"Your festive meeting is heartily shared by all chemists of the world who admire and cherish you." Just before the meeting broke up, there was distributed a photo-lithograph representing Dr. Hofmann under the emblem of Jupiter Ammon (typifying his researches on ammonium), with an aureola of aniline colours. A large number of toasts were heartily responded to; and an ode to aniline, composed for the occasion, caused general applause and great merriment.

American Journal of Pharmacy, January, 1870.

Among a great deal of strictly pharmaceutical matter, this number contains the following original papers relating to chemistry:—

Contribution to Our Knowledge of the Chemical Composition of Gelsemium Sempervirens.—Dr. Wormley.—The author made a series of experiments with the fluid extract of gelsemium, and has discovered therein a new organic acid and a new alkaloid—the former having been denominated gelseminic acid, and the latter gelsemine. The preparation and properties of these are described at very great length. In pure state gelseminic acid is a colourless, odourless, nearly tasteless, solid crystallisable substance, sparingly soluble in water, more soluble in hot water, and freely soluble in ether and chloroform; the substance is a strong acid, completely neutralising bases, and forming salts, which, excepting those of the alkalies, are sparingly soluble in water. The following is a characteristic test for this acid:—When the acid, or any of its salts in solid state, are treated with a drop of strong nitric acid, the substance dissolves under a yellow colouration, to a yellow-reddish, or red solution; if to this be added excess of ammonia, it acquires a deep blood red colour, which is permanent, at least for some hours. The 1-10,000th of a grain of the solid acid yields, with nitric acid, a well-marked yellow colouration, which assumes with ammonia distinctly a pale red hue. Gelseminiue is, in pure state, a colourless, odourless solid, having an intensely bitter taste; it has strongly-basic properties, completely neutralising the most powerful acids; in free state, sparingly soluble in water, freely soluble in ether and chloroform. It is distinguished by the property of yielding, with concentrated sulphuric acid, a reddish brown colour, which, on being moderately heated, acquires a beautiful purple colour; this reaction is produced with even 1-100th of a grain of the alkaloid, or any of its colourless salts. Addition of bichromate of potassa to this acid solution produces no marked change. The alkaloid and the fluid extract are very poisonous substances. This paper contains a toxicological research, in consequence of a case of poisoning having accidentally taken place with the fluid extract of the *Gelsemium sempervirens*, which, we believe, is a native American plant.

Adirondack Mineral Springs.—Dr. Bell.—This spring exists near the Adirondack Mountains, in the State of New York. The water may be regarded as a saline chalybeate, with a considerable quantity of free carbonic acid; it is without smell and any very marked taste. One imperial gallon was found to contain the following substances, expressed in grains:—Sulphate of lime, 11·134; carbonate of lime, 18·543; carbonate of magnesia, 16·618; carbonate of iron, 5·040; carbonate of manganese, a trace; carbonate of potassa, 5·317; carbonate of soda, 5·135; carbonate of lithia, 0·023; chloride of sodium, 14·340; alumina, a trace; insoluble residue, 7·42; free carbonic acid, 67·3 cubic inches.

Naphthaline as a Protective against Moths and other Insects.—M. Markoe.—From the statements made by the author in this paper, it appears that the well and deservedly-known *savant*, Prof. Asa Gray, has thoroughly tested and obtained highly satisfactory results, conclusively proving that naphthaline may be advantageously used in museums, herbariums, &c., instead of camphor, as a very effective protection against moths and other insects.

The Journal of the Franklin Institute, November, 1869.

This number contains the following original papers relating to chemistry and allied sciences:—

Oxygen Manufactured on the Large Scale.—Prof. Morton.—The works for this purpose are at New York, and consist of retort-houses, engine-rooms, store-house, pumps for compressing gas in cylinders, and a gas-holder of 26,000 cubic feet capacity. The process is carried on as follows:—About 700 lbs. of manganate of soda are placed in the retort and heated to the requisite degree; superheated steam from a boiler is then admitted for about ten minutes. 2 equivalents of the manganate of soda, and 2 of water, react upon each other, as indicated by the following formula:—

$$2(MnO_3,NaO)+2(HO)=2(NaO,HO)+Mn_2O_3+O_3$$

in other words, the water combines with the soda of the manganate to form a hydrate of soda, the manganic acid is converted into sesquioxide of manganese, containing only half the proportion of oxygen, and the other half of the latter passes off in free state. At the conclusion of this part of the process, the steam is shut off, and the super-

heated air is admitted for about fifteen minutes, whereupon the sesquioxide combines with more oxygen from the air, and is re-converted into manganic acid, which again combines with soda. The retorts in each furnace are charged with 700 lbs. of permanganate of soda, and by the consumption of two chaldrons of coke, and with the labour of three men, 25,000 cubic feet of oxygen are made per day. It is now sold at 5 cents (2½d.) per cubic foot, compressed in reservoirs up to a pressure of 250 lbs. to the square inch. The gas is of excellent quality and very pure.

Spectrum of the Aurora Borealis and Zodiacal Light.—M. Angstrom.

Analysis of Native Phosphate of Lead from Chester County, Pa., U. S.—Mr. Williams.—The author describes at great length his method of analysis, and quotes the following results:—(1) Mineral of dark olive-green colour contained, in 100 parts:—Phosphate of lead, 87·40; phosphate of lime ($3CaOPO_5$), 0·37; phosphate of protoxide of iron, 1·74; chloride of lead, 9·79; fluoride of calcium, 0·34; matter insoluble in acid, 0·42. (2) Of a yellowish green shade, in 100 parts:—Phosphate of lead, 85·89; phosphate of lime, 2·64; phosphate of protoxide of iron, 0·62; chloride of lead, 9·41; fluoride of calcium, 0·67; insoluble matter, a trace. (3) Mineral of a darker colour than No. 2, in 100 parts:—Phosphate of lead, 87·01; phosphate of lime, a trace; phosphate of iron, 1·39; chlorido of lead, 9·13; fluoride of calcium, 0·91; insoluble, a trace. A separate assay for silver was made, giving 0·0037 per cent, or about 1·1 ozs. to the ton of 2000 lbs.

Native Gold from Venezuela.—Mr. Williams.—It contained, in 100 parts:—Gold, 93·583; silver, 3·687; iron, 1·60; copper, 0·650. No platinum, or metals associated with it, were detected.

Various Processes for Preserving Timber.—Mr. Beer.—This paper is written by the author with the view to contradict and correct several statements made by Dr. Ott, in a paper written by the latter on this subject, and published in this periodical.

New Chemical Nomenclature.—Dr. Ott.—This paper, a continuation of a former, contains much valuable information on the history of the nomenclature previous to Lavoisier's time.

The United States' Cabinet of Practical Geology and Mining.—Mr. Wilson.—From this paper we learn that a cabinet, or collection rather, has been organised at Washington for the collection and preservation of a complete system of geological and mineralogical memorials of the whole extent of the great Republic. M. Roessler, educated at Vienna, and formerly in the Austrian geological service, has charge of this institution.

Electricity Applied to Registering Vibrations.—Mr. Cooley.

Easy Rules for Astronomical Refraction.—Mr. Lyman.

Processes for Preserving Timber.—Dr. Ott.—A continuation of a former paper. This part chiefly treats on what is called Heinemann's process of preservation, by means of forcing molten resin into timber the sap from which has been previously exhausted.

December, 1869.

Separation of Animal from Vegetable Fibre.—Mr. Stuart.—The author subjects rags, carpet cuttings, old carpets and other waste material consisting of mixed fibres, to a solution consisting of 100 gallons of hot water, 100 lbs. of commercial sulphate of alumina, and 50 lbs. of common salt. In this solution the material is kept boiling until the vegetable fibre is decomposed; the material is then well washed and dried, and scribbled, or carded.

Electro-Plating with Iron.—Mr. Clay uses a bath composed of ferrous sulphate combined with sulphate of ammonia, potassa, or soda.

Tellurium Ores in the United States.—M. Roessler.—The author states that a mineral named montanite, from the locality where it was found, is a tellurate of bismuth associated with pure telluride of bismuth; another variety contains sulphur in addition (5 per cent), and its formula is $BiS_3 + 2BiTe_3$. The montanite is a yellowish mineral, with waxy lustre, and contains, according to assay, £20,000 worth of gold to the ton of 2000 lbs. Tellurium minerals are (the author observes) very rarely met with, but when found contain generally much gold and silver, which are, however, excluded from native tellurium.

NOTES AND QUERIES.

Egg and Blood Albumen.—Can any of your readers inform me of a good method of testing the value of egg and blood albumen.—W. B.

Production of Ozone.—Would you kindly inform me, through the medium of your valuable journal, the cheapest and best mode of producing ozone in quantity, and if a process described in the *Daily Telegraph* some months since is practicable, and if protected by a patent? —X. Y. Z.

Colours and Pigments.—Can any of your readers inform me of any, or the best, works treating on the manufacture of pigment colours, painters' colours, and paper printers' colours; also, what work is the best on the manufacture of blood and egg albumen.—A Reader, Church, near Accrington.

Distilling Tar.—Can you refer me to any work that treats upon the process of distilling tar? I am in a place where I can procure 6 or 7 tons of tar from the gas works every week. There is a tar distiller not far from the town, but he will tell me nothing, even for money. I should like to know the process—how long it is boiled, what vitriol to put in, and how to separate the contents when the pitch is run off. I know that colours are made from it, as well as oil, ammonia, carbolic acid, &c.—A Chemist.

Gutta-Percha Vessels for Chemical Uses.—Erroneous views have been held and circulated concerning the durability of gutta-percha under the action of various reagents. We are ordinarily told that it is absolutely unacted upon by cold mineral acids, with the single exception of the sulphuric at 1·6 sp. gr. and upwards. This is far from being the case. There is, indeed, no immediate corrosion, or other rapid and striking change; but, in course of time, the surface becomes overspread with a thin buff-coloured layer, which may be easily rubbed off. This change extends gradually deeper and deeper, till the whole mass loses its coherence and splits in various directions. I have before me a number of jars which have been used for nitric, chlorhydric, and dilute sulphuric acids, as, also, for solutions of stannous, stannic, and ferric salts, and which, in less than three years' service, have become quite worthless; on being sent for repairs to a dealer in such articles, they were returned with the remark that they "could not be mended, as they had been used for acids." I find that the disintegration in question can be very much retarded if the vessels are always rinsed in cold water immediately after being used.—J. W. Slater.

ANSWERS TO CORRESPONDENTS.

NOTICE—The American Publishers of The Chemical News *give notice that, in accordance with a suggestion of* Mr. Crookes, *the Editor and Proprietor of the English Publication, they will be pleased to receive and forward to him in London any scientific publications issued in America, for review—and also any Notes and Queries, Articles, Correspondence, etc., for publication or reply. Their facilities of communication with* Mr. Crookes *render this very desirable to all persons in the United States who wish to confer with him. Address to him, care of*

W. A. TOWNSEND & ADAMS,
434 Broome Street, New York.

Joseph Welch.—A work, by the Editor of this journal, treating on the madder extracts and pigment colours is in the press.

March.—It cannot be made. (2) The various processes for the manufacture of artificial alizarine are all patented. (3) Messrs. Walker's address is 43, Mansell Street, Aldgate, E.

George E. Davis, Rev. E. Smith, Professor Smith (Sydney), Professor A. M. Thomson (Sydney), J. Gulson Burgess, and J. W. Slater. These correspondents are thanked for their communications, which shall receive due attention.

An Old Subscriber (Maryland, U. S.).—The address of Mr. Siebe, the maker of the refrigerating machine, is Mason Street, Lambeth, London. *Engineering* of Nov. 27th, 1868, gives a description of the apparatus in use at Truman, Hanbury, and Co.'s Brewery.

George Gore, F.R.S., Professor Heaton, Professor Cameron, and H. N. Draper.—Received with thanks.

Books Received.—"The Manchester Examiner and Times," Jan. 29, 1870, containing a letter by Dr. Bedford on "The Flames upon the Sun." "On the Combining Power of Chemical Elements," by Prof. S. D. Tillman, New York. "The Medical and Surgical Reporter."

AMERICAN SUPPLEMENT.

New York, April, 1870.

Chittenango Springs, Madison Co., N. Y.

The sulphuretted springs of Chittenango are situated in the town of the same name in Central New York, a few miles southerly from the Chittenango station of the New York Central Railroad. The three springs of the greatest importance—called the "White Sulphur," the "Cave," and the "Magnesia" springs—flow within two hundred yards of each other, near the base of a hill two hundred feet or so in height, beneath the shadow of which a hotel has been built, capable of accommodating five hundred guests.

The "White Sulphur" spring flows from the hillside, near the hotel, in an abundant stream, exhaling sulphuretted hydrogen, which can be perceived at some distance. The water has an opalescent appearance from precipitated sulphur, is cool, and has a strong sulphuretted taste.

In a cave in the same hill, but about two hundred yards to the south of the first-named spring, is found the "Cave" spring, similar in its character to the last, but less abundant; and below this, in the field, is the "Magnesia" spring—the strongest water, but the least abundant.

The following analyses were recently made in the Editor's laboratory, with the assistance of W. H. Chandler and F. A. Cairns.

The method employed for determining the sulphur compounds was a modification of the one employed by Simmler in the analysis of the Stachelberg water, the account of which was published in Erdmann's Journal, vol. 70. The alterations introduced lessen to a great extent the amount of analytical work to be done at the spring. The following brief statement may prove of interest:

1. In a glass-stoppered bottle, to one litre of water was added an excess of a neutral solution of nitrate of silver.

2. To another litre was added an excess of a solution of chloride of cadmium.

3. Through a third litre pure hydrogen was transmitted until the gas, after passing through the water, no longer decolorized a dilute solution of iodide of starch. An excess of a solution of chloride of cadmium was then added.

These three bottles were well agitated, securely sealed, and transported to the laboratory. From each the precipitate was filtered, washed, dissolved, and oxidized by fuming nitric acid and chlorate of potassa, filtered, and the sulphuric acid determined in the filtrate with chloride of barium.

No. 1. This precipitate contained the sulphur, existing in the form of sulphides and hyposulphites.

No. 2. Contained the sulphur existing in the form of sulphides, including the free sulphuretted hydrogen.

No. 3. Contained the sulphur present in the form of sulphuretted sulphides. The difference between No. 3 and No. 2 indicated the amount of sulphur as free sulphuretted hydrogen; and by deducting No. 2 from No. 1, the amount of hyposulphites was ascertained.

In the original filtrate from No. 1, the sulphuric acid was determined, after removing the excess of silver by hydrochloric acid.

The following results were obtained:

	"White Sulphur Spring." grains.	"Cave Spring." grains.	"Magnesia Spring." grains
Hydrosulphate of sodium..	0·117	0·386	0·757
Hydrosulphate of calcium .		1·123	0·929
Sulphate of soda.....	0·213		
Sulphate of lime.....	81·420	106·126	115·085
Sulphate of strontia.....	trace	trace	trace
Sulphate of magnesia.....	1·953	7·589	12·718
Hyposulphite of soda.....		0·257	0·020
Bicarbonate of magnesia...	22·017	23·973	20·779
Bicarbonate of iron	0·078	0·156	0·325
Chloride of potassium.....	0·156	0·233	0·333
Chloride of sodium.....	1·037	1·569	1·833
Chloride of lithium	trace	trace	trace
Alumina.....	0·082	0·222	trace
Silica.....	0·286	0·519	0·577
Total solid contents per gal. (231 cub. in.).....	107·359	142·113	153·356
Total sulphur in the metallic sulphides and sulphuretted hydrogen.....	0·339	1·397	2·454
CUBIC INCHES OF GAS PER GALLON.			
Sulphuretted hydrogen gas	0·884	2·754	5·623
Carbonic acid gas	20·480	15·934	19·436

Sprinkling the Streets with Chemicals.

REPORT OF PROF. C. F. CHANDLER,

CHEMIST TO THE METROPOLITAN BOARD OF HEALTH.

Mr. Moritz Marcus, in a communication to the Board of Health, states that he has invented and patented a chemical compound for sprinkling the streets, which consists of chloride of calcium and common salt dissolved in water.

Mr. Marcus claims—

1. That his compound holds moisture, and in so doing solidifies the dust; and that it need not be applied to the streets oftener than once or twice a day.

2. That it renders pavements more durable, and that it will prevent the decay of the wooden pavements.

3. That it purifies the air and removes contagion, while pure water is often injurious to health.

4. That its use will diminish the labor of watering the streets, as one sprinkling with the compound is equivalent to four or five sprinklings with pure water.

5. It costs six cents per pound, and fifty pounds are sufficient for 500 gallons of water. The labor saved by the less frequent sprinkling required when this compound is used will compensate for the cost of the material.

These are the claims which the inventor makes for his material.

The proposition is simply to use a deliquescent substance to retain moisture in street dust. Chloride of calcium and many other salts have the property of absorbing moisture from the air, which they retain at ordinary temperatures, becoming wet or even dissolving in the water absorbed to a permanent solution; the term deliquescent describes this property.

The idea of Mr. Marcus is by no means new; it has come up from time to time, and has been repeatedly shown to be impracticable. The use of chloride of cal-

cium for street sprinkling was suggested more than forty years ago.

In 1859 experiments were made in Paris, on the walks and roads of the Bois de Boulogne. It was then found that the effect lasted, in dry weather, five or six days; but that, as the chloride of calcium cost two cents per pound, and as one-half pound was required for every square yard of surface, the process was too expensive.

In 1862 experiments were again made in Paris, a cheaper impure variety of chloride of calcium being employed, upon which a Government report was published. The material cost one cent per pound, and one pound was required for every square yard of surface at each application.

The effect of an application of the material lasted about three days. In dry weather occasional sprinkling with water was necessary. Rain washed the chloride of calcium into the sewers at once. It was found that the use of this substance gave rise to the formation of a black, sticky, bad-smelling mud, very offensive to the public.

In 1864 experiments were again made at Paris, the chloride of magnesium being employed on account of its cheapness.

One pound of the material was required for every square yard of surface. It was put on at night, the effect lasting twenty-four hours; the second day a little water was required, on the third day considerable water was required. On the fourth day it was necessary to make a fresh application. The chloride of magnesium cost one-half cent per pound. The expense of sprinkling ten thousand square metres, a little more than as many square yards, for three days, including labor, material, &c., was, with chloride of magnesium, 111.90 francs, or $30.21; with pure water, 35.50 francs, or $9.58. Showing that sprinkling with a deliquescent salt, costing only half a cent per pound, costs three times as much as sprinkling with water.

In July, 1865, the engineer-in-chief of roads and bridges reported—

1. That the use of deliquescent salts is considerably more expensive than pure water for sprinkling the streets.

2. That pure water has the advantage, that, while it lays the dust, it cools and moistens the dry air of summer; while the deliquescent salts absorb the little moisture present in the air, making it dry and disagreeable, without in any way cooling it, and therefore exerting an influence prejudicial to health.

3. They form with the street dust a disagreeable, sticky, and offensive mud.

4. They can be used in those places only where they are much cheaper than in Paris, or where the necessary supply of water cannot be obtained.

From these statements it is apparent that the mixture of Mr. Marcus, costing six cents per pound, cannot be used economically, as the chloride of calcium at one cent was too expensive in Paris, and the chloride of magnesium at one-half cent per pound cost three times as much as pure water.

Mr. Marcus' other claim, that the mixture of chloride of calcium and common salt will remove contagion from the air, is probably founded upon the supposition that chloride of calcium is identical with bleaching powder, commonly called chloride of lime, which is not the case. They are entirely different substances. Chloride of calcium is not a disinfectant, and does not possess any properties which would warrant its use for sanitary purposes.

The Various Methods for the Determination and Separation of Baryta, Strontia, and Lime.

BY PAUL SCHWEITZER, PH.D.

(Continued from the February Number.)

II. *Determination of Strontia.*

Strontia is generally precipitated from its solutions as sulphate or carbonate of strontia, and weighed as such; the determination as nitrate of strontia being preferred only in special cases. The general characteristics of the salts of strontia are very much the same as those of baryta. The same precautions have to be observed in their precipitation; and the same affinity, though not quite as strongly marked, exists between them and the salts of the alkalies. In incinerating the paper on which precipitates of strontia have been filtered, special care has to be taken to remove the precipitate as much as possible from the filter, and to burn the latter at a comparatively low temperature, on account of the volatility of the strontia salts. This volatility is especially noticeable in the hydrous salts, as we get them by precipitation and subsequent drying. In fact, the precipitated and dried salts of the alkaline earths differ in a marked degree from the ignited precipitates, whether artificial or as found in nature, and a deeper study of them in the various minerals would be not only interesting to the chemist, but also afford valuable aid to the geologist.

Sulphate of Strontia.

For all the determinations of strontia, pure crystals of nitrate of strontia were pulverized and dried in a platinum dish until the weight became constant. The dried powder dissolved to a clear solution in water, and represented SrO,NO_5. In determining the strontia in the form of sulphate, we must be more careful than with the corresponding baryta salt, in order to arrive at accurate results. Sulphate of strontia is more readily soluble in water and acids than sulphate of baryta, and an excess of hydrochloric as well as of sulphuric acid has therefore to be avoided. We must further add about the same volume of alcohol, and wash the precipitate with a mixture of equal parts of alcohol and water. This precipitate has to be well washed, as in the case of the baryta precipitate, to prevent the filter paper from becoming charred by retained sulphuric acid. This acid, however, can be removed easier than in the case of sulphate of baryta, probably, as said before, on account of the very voluminous character of the freshly precipitated sulphate of strontia, which is a mere hydrate, and not a bisulphate, as stated in some books; for whether precipitated by free sulphuric acid or an alkaline sulphate, no difference exists in appearance or behavior. The precipitate of sulphate of strontia will be very voluminous at first, so that it is better to let it stand for at least twenty-four hours in the cold before filtering, when it will have lost most of its water of crystallization and have become greatly reduced in volume.

For the following three determinations nitrate of strontia was precipitated with an excess of dilute sulphuric acid; B with more acid than A, and C with more than B, and afterwards an equal volume of alcohol added. After standing twenty-four hours the precipitates had changed totally in appearance, and appeared like sulphate of baryta; they were filtered, washed with the proper precautions, dried, ignited, and weighed.

	A.	B.	C.
SrO,NO_5, used	2·1924	2·5422	2·4353
SrO,SO_3, found	1·8990	2·2000	2·1000
SrO,NO_5, calc.	2·1888	2·5357	2·4204
"	99·84 p. c.	99·75 p. c.	99·39 p. c.
	−0·16 p. c.	−0·25 p. c.	−0·61 p. c.

We learn from these analyses that too large an excess of sulphuric acid will readily dissolve some of the precipitated sulphate of strontia. The same will be the case with hydrochloric acid, but in a more marked degree; for in precipitating a neutral solution of nitrate of strontia by dilute sulphuric acid, and comparing the result with a precipitate obtained by dilute sulphuric acid in a solution acidulated by hydrochloric acid, and treating the precipitate twice with the same acid, as described under baryta, we find more than 4 per cent. of the sulphate dissolved. In these two, and also the third analysis, where neutral nitrate of strontia, after being mixed with 3 grammes chloride of sodium and 3 grammes chloride of potassium, was precipitated by dilute sulphuric acid, the bulky, voluminous precipitates were reduced to a granular condition by boiling, and after decanting the clear supernatant liquid, washed with hot water. In washing these precipitates it depended, of course, on personal experience to tell exactly the time when the precipitates were washed enough, which will be generally the case when the wash-water will give a cloudiness with a baryta salt only after some time.

	A.	B.	C.
SrO,NO_5, used	2·1860	2·4942	1·9090
$SrO.SO_3$, found	1·8667	2·0483	1·6370
SrO,NO_5, calc.	2·1515	2·3608	1·8868
	98·42 p. c.	94·65 p. c.	98·83 p. c.
	−1·58 p. c.	−5·35 p. c.	−1·17 p. c.

Hydrochloric acid will also dissolve about 4 p. c., and water about 1·5 p. c. of the precipitated sulphate of strontia, while the latter will retain about 0·5 p. c. of alkaline salts.

In the determination of sulphuric acid by means of a salt of baryta good results were obtained; but we found that, besides the affinity of the sulphate of baryta for alkaline salts, an affinity also existed for the baryta salt in solution. Those two affinities are reversedly strong in the sulphate of strontia; for while of the alkaline salt only about 0·5 p. c. is retained, of the alkaline earth a great deal more is held by the precipitate, which by long washing may be reduced somewhat in quantity; this, however, is attended again with losses, owing to the solubility of the sulphate of strontia. For the following experiments pure sulphate of potassa was precipitated by a solution of nitrate of strontia, and after boiling to reduce to the proper volume, that is, to about one-tenth of the volume of the freshly precipitated sulphate, filtered, washed, and weighed:

	A.	B.	C.
$KO.SO^3$, used	3·1915	3·8385	5·9200
$SrO\ SO^3$, found	3·4270	4·1520	6·4380
$KO.SO^3$, calc.	3·2537	3·9420	6·1124
	101·95 p. c.	102·69 p. c.	103·25 p. c.
	+3·53 p. c.	+4·27 p. c.	+4·83 p. c.

A was here washed longer than B, and B longer than C. The difference is calculated from the amount obtained by sulphate of strontia without the addition of alcohol, viz.: 98·42 p. c.; the equivalent of sulphate of strontia and sulphate of potassa giving only an actual difference of 0·05 p. c. in A. For 1·58 p. c. of sulphate of strontia lost, will amount to 0·0550 grammes for 3·4270, corresponding to 0·0522 grammes of sulphate of potassa, making in all 3·3059 gr. or 103·58 p. c.

Carbonate of Strontia.

The carbonate of strontia was precipitated in the same manner as described under carbonate of baryta. It is not so voluminous as the sulphate, chromate, or oxalate of strontia, and changes quicker than any of the others into the heavy granular form, in which it may be freed most conveniently from other salts by washing. In a number of determinations of baryta and strontia as carbonates I found it most convenient and at the same time most accurate to remove the well-dried precipitates as completely as possible from the filter, burn the latter in a platinum spiral, and bring the ashes in a platinum crucible together with the rest of the precipitate. The crucible was then heated over a Bunsen burner, so that the flame was about ½ inch distant from the bottom, and after ten or fifteen minutes the heat was raised, allowing the crucible to become at the lower half, of a dull red color for a minute or so. The results will be the same as those obtained by the troublesome treatment with carbonate of ammonia. A was precipitated without, B with the addition of alkaline salts, a very small amount of which was retained by the carbonate of strontia.

	A.	B.	
$SrO.NO^5$, used	2·7850	2·5300	
$SrO.CO^2$, found	1·9450	2·2011	as $SrO.SO^3$
$SrO.NO^5$, calc.	2·7889	2·5370	
	100·11 p. c.	100·28 p. c.	
	+ 0·11 p. c.	+ 0·28 p. c.	

Chromate of Strontia.

The following experiments with chromate of strontia were undertaken to determine the possibility of a separation of strontia from baryta by means of a chromate. We know that it is comparatively easy to precipitate chromate of strontia from a concentrated solution of a strontia salt. But the precipitated chromate of strontia is not so easily soluble as we are generally disposed to believe, for from a solution which does not contain more than $\frac{1}{40}$ of a per cent (in 100 cubic centim. 0·025 grammes SrO), we are able to precipitate, by heating, a certain amount of strontia as chromate. In fact, let me state here that the solubility of a substance, as determined by treatment with solvents, differs from the solubility of the same determined by the amount remaining in solution in the filtrate from a precipitation, notwithstanding the presence of the same salts and the similarity of the treatment; therefore all corrections in analytical chemistry must be regarded with suspicion and used with caution.

It appears that we are able within certain limits, which must be allowed in analytical chemistry (that is to say, from a fluid, which contains more than a mere trace), to precipitate more than 40 per cent of a dissolved salt of strontia as chromate. As this, however, is soluble in water, we may be able to remove it from any other precipitate by washing, yet have to wash then for a longer time, and employ a larger volume of water, than we generally would like in quantitative analysis. In appearance the chromate of strontia differs from the chromate of baryta by its bulkiness, which it retains in cold and hot solutions; while from a fluid containing very little strontia it is precipitated crystalline, and differing then still more from the chromate of baryta.

Three determinations were made, A being precipitated from a solution of 250 cb. cm. B and C from a solution of 500 cb. cm. The precipitate in A appeared

immediately, while in B and C it appeared after some time upon boiling.

	A.	B.	C.
SrO,NO_5, used	2·6040	0·7405	0·2660
SrO,CrO_3, found	1·8865	0·3080	0·1080
SrO,NO_5, calc.	1·9558	0·3193	0·1124
	75·10 p. c.	43·12 p. c.	42·25 p. c.
	−24·90 p. c.	−56·88 p. c.	−57·75 p. c.

The precipitates were filtered after 24 hours standing, and after sufficient washing weighed on a dried filter. They contained mere traces of alkalies before the spectroscope, and seem to indicate that about 40 per cent is the limit to which strontia can be thus precipitated.

Oxalate of Strontia.

The same may be said with regard to oxalate of strontia as has been said about oxalate of baryta. It is more soluble than the lime salt, not quite as voluminous as the baryta salt, and differs more from the carbonate of strontia in appearance and behavior than the oxalates of baryta and lime differ from their carbonates. It will retain only traces of alkaline salts, and even those may be removed by long washing. A and B were precipitated from a solution of 500 cb. cm., B after the addition of 3 grammes of KCl and 3 grammes of NaCl, and the precipitates washed with hot water.

	A.	B.
SrO,NO^5, used	2·7150	2·8230
SrO,SO^3, found	2·2910	2·3842
SrO,NO^5, calc.	2·6406	2·7480
	97·26 p. c.	97·36 p. c.
	−2·74 p. c.	−2·64 p. c.

The Spectrum of Artificial Alizarine.

COMMUNICATED BY PROFESSOR JOHN H. APPLETON, OF BROWN UNIVERSITY, R. I.

My assistant, Mr. H. W. Vaughan, has been making a series of observations on the spectra of various colored solutions. In the course of the experiments we have observed the interesting fact, that *the spectrum of artificial alizarine is identical with that of alizarine extracted from madder.*

In making these experiments the inverted microscope of J. & W. Grunow, of New York, was used, but attached as an eyepiece was a micro-spectroscope of the Sorby-Browning pattern, for the comparison of two spectra at once. The micro-spectroscope was also made by Grunow.

The *alizarine of madder* employed was the commercial article produced by Messrs. Schaff & Lauth, of Strasbourg; the *artificial alizarine* was that furnished by Messrs. Perkin & Son, of London.

Considerable difficulty was at first experienced in obtaining a solution which would give a satisfactory spectrum, but this difficulty was at length overcome as follows: First the alizarine was in each case purified by placing it in a platinum capsule and covering with a glass funnel, into which the alizarine was sublimed at a gentle heat. The yellow crystals thus produced were then dissolved in *caustic soda*, that reagent being found to afford a solution which furnished far the most characteristic spectrum. This alkaline solution was gradually diluted until of such strength as to give a good spectrum; or the solution was placed in a wedge-shaped glass cell, such that, by moving the cell, solutions of different thicknesses were obtained with very little trouble.

Italian Petroleum.

Not long since a grant was obtained from the Italian Government of the exclusive right to sink wells for petroleum in an extensive tract of country on both sides of the Taro river, in the province of Parma, a few miles south-east of the city of Parma. Samples of the petroleum found in the district were brought to New York, with a view of interesting capitalists here in the enterprise. These samples were examined in the editor's laboratory, and as they present some remarkable contrasts in composition, although they were all collected upon a tract of thirty square miles, we think the results should be placed on record. The tract of land forms a basin between spurs of the Apennines, around and between the villages of Fornovo, fourteen miles from Parma and Medesano, ten miles from the same city. According to Prof. Stoppani, of Milan, the valley, in its geological formation, partakes of the character of the Apennines, consisting of three great deposits or layers, belonging to an epoch anterior to the Tertiary, of which the following is a section:—

5. Soil abounding in marl, covered with an ash-colored sand containing Tertiary fossils.
4. Tertiary deposits, generally horizontal.
3. A series of strata of marl and calcareous conglomerate, containing remains of marine plants, and more or less inclined.
2. Argillaceous schist, marlite, and calcareous rocks.
1. Mixture of gneiss, mica schist, and calcareous rock.

The entire territory bears evident marks of volcanic action, such as the appearance of huge blocks of serpentine abruptly emerging from the ground; the extensive oozing out of gaseous mud and gases; springs of brine, mineral waters, and petroleum. Oil-wells have long existed in this region. Volta mentions them; and Amoretti, a writer of the last century, says he saw, near Miano, a well 125 feet deep, full of petroleum. In 1802 there was a flowing well at Miano, which yielded an abundant supply of oil. Parma and the town of San Domingo were lighted with it for several months. Its use was discontinued chiefly for want of suitable lamps.

A merchant in Parma has of late monopolized the trade; before the introduction of American petroleum he sold about 24,000 kilogrammes per annum.

There is a very marked difference in the appearance of the oil from different points on the tract. The oil from the neighborhood of the Church of St. Andrea has a reddish color, like burnt sugar, while the oil from Miano is of a pale yellow color.

At St. Andrea there are about 100 wells, mostly abandoned, having an average depth of 180 feet. At a little depth, salt water is generally found; as the well is driven deeper, petroleum generally appears. One well yielded 800 kilogrammes of oil per day for some time, but was finally abandoned for want of the proper masonry to support the sides. The oil sold for from $2.50 to $3.00 per gallon. The wells are generally 4 or 5 feet in diameter, are cylindrical, and are walled from mouth to bottom. The oil is never pumped, but is skimmed, every week or fortnight, from the surface of the water on which it floats, by means of a copper or iron pail attached to a cord.

In digging wells gases are evolved in large quantities. Within the recollection of persons now living, seven men have been killed in wells by the gases. The following are the results of the chemical examination made by C. F. Chandler and M. Alsberg. The samples

were examined by fractional distillation, and the results were arranged according to the usual American standard, which recognizes as—

1. Gasolene.....all above 65° Baumé.
2. Naphtha..... " between 65° and 60° B.
3. Burning oil... " " 60° and 36° B.
4. Lubricating oil " below 36° B.

The percentages represent volumes, not weights.

No.	Locality.	Density.		Gasolene, above 65° B.	Naphtha, 65° to 60° B.	Burning Oil, 60° to 36° B.	Lubricating Oil, Below 36° B.	Coke and Loss.
1	Fornovo District.....	0·9065	25° B.	..	..	..	94·50	5·50
2	" "	0·9060	25° B	..	..	..	96·60	3·40
3	Fornovo District, Ozzano	0·9065	25° B.	..	..	..	97·03	2·97
4	" " "	0·9081	25° B.	..	..	..	96·61	3·39
5	Medesano District, Miano	0·9125	24° B.	..	..	..	97·27	2·73
6	Fornovo Dist., Neviano del Rossi.....	0·8922	28° B	..	..	39·81	56·76	3·43
7	Medesano District, Miano	0·8572	34° B	..	..	58·93	38·21	2·86
8	Fornovo District, Ozzano	0·9021	26° B	..	..	28·33	77·93	3·74
9	Fornovo Dist., Neviano del Rossi.....	0·7960	47° B	..	10·00	78·21	9·64	2·15
10	Fornovo Dist., Neviano del Rossi.....	0·7826	50° B.	..	9·20	89·65	..	1·15
11	Pennsylvania average...	0·8110	44° B.	10·00	10·00	76·00		4·00

The first five samples are heavy lubricating oils; 1 to 4 exhibit a clear red color; while No. 5 has a dark yellowish brown color. They are almost free from odor, and none of them yield any "burning oil." Nos. 6, 7, and 8 are lighter oils, containing burning and lubricating oil, but no gasolene and no naphtha. No. 6 has a greenish yellow color; No. 7, a clear yellow; No. 8, a clear red color. They all possess an agreeable odor. No. 9 has a deep yellow color, faint odor, and contains naphtha. No. 10 is the most remarkable of the entire series. It has a pale straw color, an agreeable odor; contains naphtha, but no lubricating oil; it consists almost entirely of burning oil No. 11 is an average sample of Pennsylvania petroleum fresh from the wells.

These Italian oils are very remarkable in differing from each other to such a degree, when they come from wells so near each other. They are also characterized by their freedom from the disagreeable odor so characteristic of much of the American petroleum.

Saltness of the Waters Around the Island of New York.

With a view to determining whether the waters around New York island were sufficiently salt to warrant the erection, at the middle and upper portions of the city, of fish markets, where the fish should be kept alive in basins or cribs, the following analyses were made in the editor's laboratory:—

I.—North River, on the South and West Sides of the Island.

Locality.	Depth.	Salt contained in one U. S. Gallon.
Between Castle Garden and Governor's Island, below the City.....	Surface.....	807 grains.
Off 25th street, 300 ft. from pier head.....	Bottom, depth, 26 feet.....	1,037 "
Off 25th street, 300 ft. from pier head.....	Surface.....	328 "
Off 25th street, mid-channel.....	Bottom, depth, 36 feet.....	1,140 "
Off 51st street, 400 ft. from pier head.....	Bottom, depth, 36 feet.....	812 "
Off 51st street, 400 ft. from pier head.....	Surface.....	266 "

II.—East River.

Locality.	Depth.	Salt contained in one U. S. Gallon.
Off 35th street.....	Surface.....	1,088 "

These results show that the water of the Hudson river flows over the heavier water of the bay; and notwithstanding the ebb and flow of the tides, admixture of the fresh and salt water takes place imperfectly. There is some difference in the specific gravity of the waters; but one would not suppose the difference sufficient to prevent mixture when the entire depth of water is but from 26 to 36 feet. The lightest water from the surface off Fifty-first street, in the North river, had a density of 1·00055, while the water from the bottom at the same spot had a density of 1·00135. The heaviest water, from the bottom, in mid-channel, off Twenty-fifth street, had a density of 1·018.

These samples were not all taken at exactly the same moment; two or three hours were spent in sailing round the island to collect them, consequently they do not all represent the same condition of the tide. They show, however, that fish markets can be erected as high as Fifty-first street, and that a supply of salt water can always be obtained by drawing from the bottom, or by making an inclosure which should be provided with openings for the supply of water, near the bottom only.

Recent examinations by Dr. H. Endemann, at the laboratory of the Board of Health, have shown that these waters are not rendered specially impure by the sewage poured into them all along the margin of the island.

The Purity of Croton Water.

The water supplied to the citizens of New York, at the liberal rate of 65 gallons to each person daily, is collected by the various branches of the Croton river from an area of 338 square miles in Westchester, Putnam, and Dutchess counties. The character of this water-shed is a sufficient guarantee of the purity of the water. The surface of silicious gravel rests on hard Laurentian gneiss, and is open pasture or woodland, with few swamps. No factories line the streams, which are liable to contaminate the waters with refuse chemicals, and no towns or large villages exist anywhere in the district to pollute the waters with sewage. A recent survey of the water-shed has indicated fifteen points at which dams can be erected for the creation of large storage reservoirs, whose joint capacity would be 67,000,000,000 gallons, or a supply, at the present rate of consumption, for 1000 days. One of these dams, 650 feet long, is now in process of construction at Boyd's Corner, in Putnam county, 23 miles from the mouth of the aqueduct. When this dam is completed, it will flood an area of 303 acres, and the reservoir thus produced will contain 3,369,206,857 gallons, or a supply for 50 to 55 days of drouth.

An analysis of the Croton water recently made in the editor's laboratory gave the following results for one U. S. gallon of 231 cubic inches:

	Grains.
Soda	0.326
Potassa	0.097
Lime	0.988
Magnesia	0.524
Chlorine	0.243
Sulphuric acid	0.322
Silicia	0.621
Alumina and oxide of iron	a trace
Carbonic acid (calculated)	2.604
Water in bicarbonates (calculated)	0.532
Organic and volatile matter	0.670
Total	6.927
Less oxygen, equivalent to the chlorine	0.054
	6.873 grs.

These acids and bases are probably combined in the water as follows:

	Grains.
Chloride of sodium	0.402
Sulphate of potassa	0.179
Sulphate of soda	0.260
Sulphate of lime	0.158
Bicarbonate of lime ($CaO,HO,2CO_2$)	2.670
Bicarbonate of magnesia ($MgO,HO,2CO_2$)	1.913
Silicia	0.621
Alumina and oxide of iron	a trace
Organic matter	0.670
Total	6.873

On evaporating a gallon of this water a residue of only 4.78 grains is obtained, the bicarbonates of lime and magnesia being left as simple carbonates.

The following tabular statement shows how favorably the Croton compares with the waters supplied to other cities:

PURITY OF CITY WATERS.

Impurities contained in one wine gallon of 231 cubic inches expressed in grains.

City.	Source.	Inorganic Matter.	Organic and Volatile Matter.	Total Solids.
New York.	Croton, 1869	4.11	0.67	4.78
" " .	Well, 8th Av.	38.95	4.59	43.54
Brooklyn..	Ridgewood, 1869	3.37	0.59	3.92
Jersey City.	Passaic River	4.58	2.86	7.44
Trenton....	Delaware River	2.93	0.55	3.48
Philadelphia	Schuylkill River	2.30	1.20	3.50
Boston.....	Cochituate Lake	2.40	0.71	3.11
Albany	Hydrant	8.47	2.31	10.78
Troy.....	Hydrant	6.09	1.34	7.43
Schenectady	Well, State St.	46.88	2.33	49.21
Utica.....	Hydraut	5.50	0.96	6.46
Syracuse....	New Reservoir	12.13	1.80	13.93
Rochester...	Genesee River	12.02	1.23	13.25
Cleveland...	Lake Erie	4.74	1.53	6.27
Chicago....	Lake Michigan	5.62	1.06	6.68
Dublin.....	Lough Vartry	1.77	1.34	3.11
London.....	Thames River	15.55	0.83	16.38
"	Well, Leadenhall St.	90.38	9.59	99.97
Paris.....	River Seine	7.83	1.00	8.83
Amsterdam.	River Vecht	14.45	2.13	16.58
" .	Well	64.55	4.38	68.93

Lead in the Croton Water.

The attention of the Metropolitan Board of Health having been called to the frequent cases of chronic lead poisoning which occur in the city, the chemist to the Board, C. F. Chandler, was directed to investigate both the Croton water and the various hair tonics, washes, etc., with a view to discovering the probable cause.

Accordingly examinations were made of Croton water which had been in contact with lead for different lengths of time, under usually occurring circumstances, of which the following are the results.

1. A gallon of Croton water from a lead-lined cistern, in which it had stood several weeks, was found to contain 0·06 grain of metallic lead.

2. A gallon of water which had remained six hours in the lead pipes of the chemist's residence yielded 0.11 grain metallic lead, a considerable portion of which was visible to the eye, in the form of minute white spangles of the hydrated oxycarbonate ($PbO,HO + PbO,CO_2$).

3. Water drawn from one of the hydrants of the School of Mines laboratory, in the middle of the day, when the water was in constant motion, yielded traces of lead. This water reaches the school through about 100 to 150 feet of lead pipe.

These results indicate the source of many hitherto unaccountable cases of lead poisoning, and are of a character to alarm the residents of New York, and to lead them to adopt precautionary measures, for protection against this insidious cause of disease. Many have already introduced, as a substitute for lead pipe, the "tin-lined" or "lead-encased block tin" pipe.

Certainly no pains should be spared to impress upon servants the importance of allowing the water to run for a few minutes before taking it for drinking or cooking purposes, specially early in the morning, after the water has stood all night in the pipes. The habit of filling the tea kettle from the boiler, or of using water from the boiler for any purpose except washing, is very dangerous.

Experiment No. 2 explains a case which recently occurred in New York. An elderly gentleman was completely prostrated with paralysis or palsy. His physician at once suspected lead poisoning from his symptoms, and instituted inquiries which developed the fact that the patient had been using wheaten grits for dyspepsia, and that the first duty of the cook in the morning had been to soak them, preparatory to boiling them. She had therefore used daily the water which had stood all night in the pipes. The occurrence of a considerable portion of the lead in experiment No. 2, in suspension, instead of solution, is an additional argument for the use of filters, though it will of course be useless to employ them unless they are frequently reversed, that they may be cleansed.

Provisions against Kerosene Accidents—A New Bill before the Legislature.

The following is a literal copy of the bill introduced in the State Senate, on the 11th inst., by Senator Norton, relating to the better protection of the public against accidents from the use of kerosene oil:

AN ACT TO PROVIDE AGAINST KEROSENE ACCIDENTS IN THE CITIES OF NEW YORK AND BROOKLYN.

The People of the State of New York, represented in Senate and Assembly, do enact as follows:

Section 1. It shall not be lawful for any person, firm, or company, in the cities of New York and Brooklyn, to

deal in, sell, or give away any refined petroleum, kerosene, or other burning fluid, at retail, or in less quantities than five barrels, for illuminating purposes in any dwelling-house, store, shop, restaurant, car, coach, or other vehicle, unless such article shall stand a fire-test of not less than one hundred and ten degrees (110°) Fahrenheit, as indicated by the most improved pyrometer. No person, firm, or company shall deal in, sell, or give away any refined petroleum, kerosene, or other burning fluid, without taking out a license therefor, which license shall be granted for one year by the Mayor of the respective city, upon payment of the sum of ten dollars for each license, a certificate of which shall contain the name of the person, firm, or company, and the precise place at which the business is to be carried on; the certificate shall be posted in some conspicuous place upon said premises. The funds so collected shall be deposited in the City Treasury.

Sec. 2. The Mayor of the city of New York shall, within ten days after the passage of this act, appoint three inspectors, and the Mayor of the city of Brooklyn shall, within the same time, appoint two inspectors. The inspector shall hold office at the will of the Mayor, and shall receive an annual salary of not more than three thousand dollars, payable from the funds derived from the issue of licenses, in monthly payments, by order of the Mayor upon the City Treasurer. It shall be the duty of the inspector, when called upon by any vender, purchaser, or other reputable person, or whenever he has good reason to suspect any violation of the provisions of this act, to inspect and test any refined petroleum, kerosene, or other burning fluid, by the most improved instrument. The inspector shall be entitled to receive from the person at whose request he shall make such examination, the sum of twenty-five cents for each cask, barrel, can, or other vessel inspected. From the sums so collected the inspector shall be paid for expenses incurred in carrying out the provisions of this act, and the remainder shall be paid over to the City Treasury.

Sec. 3. Any person violating any of the provisions of this act shall, upon complaint of the inspector, be subject to arrest by warrant of Court or Magistrate, and shall, upon trial and conviction, pay a penalty of not less than one hundred dollars, and not more than five hundred dollars. And in case death ensues from any violation of the provisions of this act, the party offending shall be deemed guilty of a felony, and subject to a fine of not less than one thousand dollars, and not more than five thousand dollars, or imprisonment for not less than one year, nor more than five years; the fines to be paid into the Treasury of the city where such conviction shall be had.

Sec. 4. This act shall take effect immediately.

We hail with delight the movement at Albany, which promises to do something to diminish the terrible accidents which result from dangerous kerosene.

We cut, during the year 1869, from the morning and evening paper which we read daily, the record of kerosene accidents, which resulted in

52 Deaths, mostly of women and children,
50 Serious injuries,
6 Slight injuries.

108 Sufferers.

It cannot be presumed that this list includes a tithe of the accidents which actually occur.

Not one of these accidents could have happened had the oil been of good quality.

We have now examined, at the rooms of the Board of Health, 636 specimens of kerosene purchased of retail dealers in the metropolitan district, with the following results:

Safe by both tests	21
Flash below 100° F, but do not burn below 110° F.	280
Below both tests	335
Total	636

Out of six hundred and thirty-six samples only 21 safe. Some of these dangerous oils were *naphtha*, and the dealers were not satisfied with selling this most dangerous substitute for safe oil, but they sold it as "*American Safety Gas.*" Is there any punishment severe enough for men whose cupidity is so uncontrollable that they will thus, for a few cents per gallon, risk consigning helpless women and tender children to the flames?

Though we shall rejoice to see any law enacted which will control this dangerous business, we feel called upon to point out some very important defects in the bill now before the State Senate.

1. The *burning test* is not the best test; the *flashing test* is the one that should be exclusively relied upon in testing oils. The accidents arise generally from the *vapors* which escape from the oil, and which by mingling with the air produce explosive mixtures.

Two or three per cent. of naphtha may make an oil highly dangerous in this respect, so that it will flash below 100° F., and yet its burning point may be above 110° F. Two hundred and eighty of the specimens which we tested would pass for safe oils under this law, and yet every one of them flashed below 100° F., and was liable to produce an explosion. The English law relies entirely upon the flashing point, which is fixed at 100° F.

In Section 1st the following words should be changed: "*Unless such article shall stand a fire-test of not less than one hundred and ten degrees* (110°) *Fahrenheit, as indicated by the most improved pyrometer,*" and made to read, "*which shall evolve a combustible vapor at a temperature below one hundred* (100) *degrees of the Fahrenheit thermometer.*"

2. The following provision should be included in the law: "*It shall not be lawful for any person, firm, or company to deal in, sell, or give away any* petroleum, or product of petroleum, kerosene or other oil, which emits a combustible vapor at a temperature below one hundred degrees (100°) of the Fahrenheit thermometer, except each package of the same be labelled, in clear and distinct characters, "*highly dangerous,* liable to *explode below* 100° *Fah.*" And it shall not be lawful to label, mark, or dispose of such an article under any name which can lead persons to suppose that it is intended for burning in lamps.

3. Three inspectors are entirely unnecessary for the city of New York. The positions would soon become mere sinecures. It would not be necessary to enforce the law a dozen times, to fine a few dealers, and send one or two to prison for from one to five years, to drive dangerous kerosene entirely out of the market. An inspector, if he knows his business, can easily, with one assistant, test in the most careful manner thirty or forty samples a day, or say ten thousand per annum.

I am confident five hundred or one thousand tests,

if the law was properly enforced, would drive the unsafe oils entirely out of the State.

4. The law seems to make the prosecution of offenders entirely optional with the inspector, for it says, Section 3: "Any person violating any of the provisions of this act shall, *upon complaint of the inspector*, be subject to arrest by warrant of court or magistrate," etc.

This will be a very dangerous power to put into the hands of the inspectors. It will give them an opportunity to test oils, and compound felonies without limit, in the quietest and most profitable manner possible.

The law should be made general. *Let the crime be defined, and* then let every one be entitled to enter a complaint, and simply require proof as to the flashing of the oil below 100° Fah.

Every one should be entitled to come into court and prove by competent experts the dangerous character of the oil. The inspectors should not constitute the only prosecutors, nor the only competent witnesses.

We want a law which will give us the full est protection against kerosene accidents. And specially do we desire to avoid placing any person in a place so thickly beset with temptations as the office of an inspector under the propose l bill.

A Simple Lecture Experiment.

Having occasion to exhibit the solubility of carbonate of lime in water containing carbonic acid, we have found the syphon bottles of carbonic acid water very convenient for the purpose.

A quantity of clear lime-water is placed in a jar, and some of the carbonic acid water injected into it, when a copious precipitate of carbonate of lime is produced. On adding a further quantity of carbonic acid water, the precipitate speedily dissolves to a perfectly clear solution. The addition of ammonia causes the carbonate of lime to reappear.

Recent Chemical Patents.

Issued February 8, 1870.

97,541.—Malting Grain.—Rudolph d'Heureuse, New York.

97,588.—Manufacture of Iron, and Granulating the Same.—Wm. H. Perry, Sharon, Pa.

97,615.—Manufacture of Yeast for Distillers.—Joseph Wolff, Lexington, Ky.

97,624.—Manufacture of Steel.—J. Baur, New York.

97,628.—Preserving Fruits, Vegetables, etc.—L. Bradley and T. D. Philips, Buffalo, N.Y.

97,637.—Treating Argillaceous Limestones to obtain Hydraulic Cement, etc.—F. Coignet, Paris.

97,738.—Process of Treating Petroleum.—J. A. Tatro, Hartford, Conn.

97,733.—Expelling Volatile Matter from Peat and other Materials.—T. G. Walker, New York.

97,735.—Cleansing Paper when Reduced to Pulp from Coloring Matters.—N. W. Wilder, Lawrence, Mass.

97,739.—Composition for Moulding Picture-Frames, etc.—Henry Wurtz, New York.

97,740.—Preparing Anhydrous Grahamite.—H. Wurtz, New York.

Issued February 15, 1870.

97,773.—Process and Material for Ornamenting Textile Fabrics.—C. Gunther, Berlin, Prussia.

97,808.—Process of Welding Cast or Bessemer Steel.—J. Absterdam, New York.

97,823.—Indigo Soap.—H. C. Borgner, Lebanon, Pa.

97,885.—Coloring Matter to be used in Vulcanized Rubber. J. Halliday, Lynn, Mass.

97,907.—Pigment for Distemper Painting.—H. M. Johnston, New York.

97,924.—Manufacture of Fertilizers and in Extracting Oils and Fats.—O. Lugo, Baltimore, Md.

97,935.—Manufacture of India-Rubber and Gutta-Percha Goods.—John Murphy, New York.

97,949.—Process and Apparatus for the Manufacture of Salt.—D. Reynolds, Albany, N. Y.

97,956.—Coloring Vulcanite or Hard Rubber.—A. D. Schlesinger, College Point, L. I.

97,975.—Manufacture of Paraffine and Paraffine Oil.—H. W. C. Tweddle, Pittsburg, Pa.

97,976.—Apparatus for Ascertaining the Amount of Acid in Liquids.—Henry Teichell, Cincinnati, Ohio.

97,978.—Fertilizer from Glue Residuum.—A. Van Haagen and W. Adamson, Philadelphia, Pa.

97,979.—Soap Product from Glue Residuum.—A. Van Haagen and W. Adamson, Philadelphia, Pa.

Issued February 22, 1870.

100,003.—Process and Apparatus for the Manufacture of Iron and Steel.—Henry Bessemer, London, Great Britain.

100,071.—Process of Bleaching and Cleaning Vegetable Fibres.—E. T. Rice, New York.

100,095.—Deoxidizing and Carbonizing Iron Ores.—C. Adams, Philadelphia, Pa.

100,109.—Manufacture of Paper.—E. B. Bingham, Newark, N. J.

100,131.—Manufacture of Copper and in Separating other Metals therefrom.—J. B. Elkington, Birmingham, England.

100,153.—Manufacture of Fertilizers from Animal Substances.—Orazio Lugo, Baltimore, Md.

100,208.—Manufacture of Gas from Petroleum.—Levi Stevens, Washington, D. C.

Issued March 1, 1870.

100,304.—Manufacture of Pottery, etc.—Philip Marquardt, Buffalo, N.Y.

100,309.—Purification of Coal-Gas.—Emerson McMillin, Ironton, Ohio.

100,327.—Disinfecting Compound.—L. S. Robbins, New York.

100,347.—Fertilizer from Excrements.—Friedrich Wicke, Bockenheim, Julius Brunner, Theodor Petersen, and J. G. Zehfuss, Frankfort-on-the-Main, Prussia.

100,352.—Method of Preserving the Aromatic Principle of Hops.—Henry Bartholomay, Rochester, N.Y.

100,353.—Manufacture of Dry White-Lead.—E. O. Bartlett, Birmingham, Pa.

100,358.—Compound for Preventing Incrustation in Steam-Boilers.—Geo. Buks, Marine, Ill.

100,365.—Manufacture of Madder Dyes.—Thos. Bristow, Cranston, R.I.

100,380.—Seasoning and Preserving Wood.—J. C. Day, Hackettstown, N.J.

100,432.—Manufacture of Illuminating Gas from Coal and other Materials.—George McKenzie, Glasgow, Scotland.

100,433.—Compound for the Manufacture of Illuminating Gas.—George McKenzie, Glasgow, Scotland.

100,435.—Manufacture of Hard Rubber.—John B. Newbrough, New York.

100,457.—Preparing Ammoniated Sulphuric Acid for the Manufacture of Fertilizers.—C. U. Shepard, Jr., Charleston, S.C.

Issued March 8, 1870.

100,497.—Desulphurizing Ores.—Elizabeth A. Burns, Meadow Lake, Cal.

100,520.—Tanning.—A. D. Fallmer, Buffalo, N.Y.

100,523.—Process of Pulping and Bleaching Paper Stock.—J. W. Goodwin, Petersburg, Va.

100,553.—Purifying Acetic Acid.—T. L. Olden, Brooklyn, N.Y.

100,605.—Composition for Preserving Timber and Wood.—Edward J. De Smedt, New York.

100,629.—Treating Blood for the Preparation of Fertilizers, and for other Purposes.—H. A. Hoget, New York.

100,647.—Treating Liquor containing Gelatine or Glue.—Orazio Lugo, Baltimore, Md.

100,668.—Manufacture of Illuminating Gas.—A. C. Rand, New York.

100,689.—Manufacture of Ice and Cooling Air, Liquids, etc.—Charles Tellier, Paris, France.

Issued March 15, 1870.

100,736.—Apparatus for the Production of Ozone.—C. F. Dunderdale, New York.

100,871.—Manufacture of Fertilizers.—J. Y. Diaz, Havana, Cuba.

100,876.—Process of Treating Acid Residuum from Oil Refineries.—Alonzo Farrar, Brookline, Mass.

100,915.—Production of Light from Heavy Hydrocarbons.—R. S. Merrill, Cambridge, Mass.

100,936.—Extracting Turpentine from Pine Trees.—J. C. Shuler, Cane Hoy, S.C.

100,944.—Manufacture of Cement for Artificial Stone.—Stanislas Sorel, Paris, France.

100,945.—Manufacture of Artificial Stone.—Stanislas Sorel, Paris, France.

100,953.—Manufacture of Rosin Oil.—Joseph Treat, New York.

Reissues.

3,857.—Use and Application of Fuel in Metallurgic and other Furnaces.—J. D. Wheelhey and J. J. Storer.

3,864.—Compound for Treating Hides and Skins.—L. F. Morrison, Morrisania, N.Y.

3,867.—Process of Treating Petroleum.—J. A. Tatro, Hartford, Conn.

3,873.—Manufacture of Gas.—W. S. Nichols and Alonzo C. Rand, New York.

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ON THE TESTING OF PETROLEUM SPIRIT.

BY F. GRACE CALVERT, F.R.S., F.C.S.

I HAVE read with much interest of late several papers on the Petroleum Act of 1868, and on the uncertainty of getting good results when testing the "flashing-point" of petroleum spirit, especially the papers published by Mr. Paul in the CHEMICAL NEWS and a pamphlet by Mr. Norman Tate, Liverpool. I therefore deemed it my duty to make a series of experiments, with the hope of throwing some light on the subject; the more so that the defect of the Act of 1868 is that no length of time is specified for raising the petroleum spirit from natural temperatures to its flashing-point. Thus the Act states:—

"The outer vessel shall be filled with cold or nearly cold water. A small flame shall be applied at the bottom of the outer vessel; and the thermometer shall be inserted into the oil so that the bulb shall be immersed about one-and-a-half inches beneath the surface."

What is understood by a "*small flame?*" appears to me a difficult question. Shall it be so that it will require fifteen, twenty, or thirty minutes to raise the petroleum spirit from natural temperatures to its flashing-point (say 98° or 105° F.)? The Act does not state.

The following experiments made with six samples of petroleum spirit, placed in my hands by the magistrates of Manchester, will show how important the above question is with reference to the testing of petroleum spirit, and the absolute necessity, for the safety of the public as well as for the interests of those who deal in the article, that the act should define the exact space of time that should be employed in the testing of any sample of petroleum spirit:—

Sample of petroleum spirit. at 52° F.	Time. 15 minutes.	Time. 20 minutes.	Time. 30 minutes.
No. 1	96° F.	98° F.	102° F.
" 2	92° "	99° "	101° "
" 3	90° "	98° "	101° "
" 4	94° "	96° "	104 "
" 5	96° "	98° "	110° "
" 6	95° "	99° "	108° "

These results clearly show the influence of time in raising six samples of petroleum from 52° F. to their flashing-points. Thus, when fifteen or twenty minutes are employed, the whole six samples tested could not be called "petroleum," according to the Act of 1868, and the owner would be liable to a penalty, and to the loss of the fluids; whilst, if the time employed to heat the liquid is half an hour, they would all be considered petroleums, their flashing-points being above 100° F.

Therefore, there can be no doubt that, according to the time employed, so are the results altered; the longer an operator is in completing his test, the higher will be the flashing-point of the spirit. This fact is probably due that the most volatile products gradually escape in the atmosphere, and are never in sufficient quantity to produce a "*flash*" when a taper, as described in the Act, is passed within a quarter-of-an-inch from the surface of the spirit. I am, therefore, of opinion that, as the Act has been made to protect the public against fire, or explosions resulting from the employment of too highly inflammable hydrocarbons, the chemist or person called upon to test liquids of this class should raise the temperature of the fluid under examination as quickly as possible (of course, employing the apparatus described in the Act), otherwise, they favour the vendor and manufacturer, to the detriment of the consumers.

The next series of experiments were made with a view of corroborating a statement made by Mr. Norman Tate, Liverpool, viz., if two thermometers are placed into the petroleum spirit, one, as indicated in the Act, 1½ inches below the surface of the liquid, the other thermometer only ½ an inch, a difference of several degrees will be noticed between them at the time the vapours will flash; and I am happy to say that the following results confirm Mr. Tate's interesting observations.

	1½ inches. Flashed at	½ an inch. Flashed at
No. 4	94° F	99° F.
" 5	94° "	98° "
" 6	95° "	99° "

This curious and unusual fact of a fluid having a much higher temperature near the surface than it has an inch below what may be considered as the centre of the bulk of the fluid, is due, in my opinion, that petroleum, not being a homogeneous liquid, but a mixture of several hydrocarbons, the highest products being first expelled, the heat rises towards the surface, and in this way produces the difference of temperature referred to. It was with a view of overcoming this practical difficulty that a series of experiments were instituted, in which the operations were conducted in the usual way, with this exception, that the liquid was kept in a constant state of agitation (except at the time when the flame was passed over to observe the flashing-point) by the thermometer; and the results obtained were as follows:—

No. 1 did not flash at 102° F.		
" 2 flashed at	99 F.	Fourteen minutes.
" 3 " "	98° F.	"
" 4	—	
" 5 flashed at	98° F.	
" 6 " "	104° F.	

These experiments appear to me to confirm the explanation above given on the cause which produced the difference of the two thermometers placed at unequal depths in the fluids under examination, for it will be observed that the flashing-points of the hydrocarbons are raised several degrees. In my opinion, this fact is due that agitation having facilitated the gradual escape of the most volatile products, the flash will not occur until a sufficient quantity of the more dense vapours have been volatilised and collected on the surface of the fluid to be tested.

I believe that many of the anomalies above described are principally owing to the difficulty—notwithstanding any amount of care that may be bestowed on the operation—to raise the temperature of the petroleum spirit from natural temperatures in a certain time (say fifteen, twenty, or thirty minutes) to their flashing-points. As the true flashing-points of the fluids depend entirely on the time employed in raising its temperature, I would propose the following method, which will enable every operator, in any part of the United Kingdom, to determine the flashing-point of a petroleum with cer-

[English Edition, Vol. XXI., No. 535, page 85.]

tainty, and feel satisfied that another manipulator would obtain similar results.

The process consists in heating water to 10° above the flashing-point of the spirit (approximately tested) in the outer vessel (such as described in the Act), removing the flame, and then placing the can in the water, filling it at once carefully with the petroleum spirit. The thermometer should then be placed with the bulb ½ an inch below the surface of the spirit, and the flashing-point then ascertained in the usual manner. The following are the results I obtained with the same six samples of petroleum which I employed in my previous experiments:—

		First experiment.	Second experiment.
No. 1	flashed at	98·0° F.	99° F.
" 2	" "	95·0° "	96° "
" 3	" "	96·0° "	97° "
" 4	" "	96·0° "	97° "
" 5	" "	96·5° "	97° "
" 6	"	—	—

I am also of opinion that a gas-flame should be employed, in preference to a spirit-lamp, when the test is made in a similar manner to the directions given in the Act, as greater regularity in the rise of temperature can be secured. I have also used in my experiments (and I advise every one to do so) the excellent suggestion made by Mr. Norman Tate—viz., a small gas-flame, instead of that produced by a match or taper, for testing the flashing-point of the spirit.

I consider the apparatus proposed by Mr. Miles would tend to give certainty to the assay, which, at the present time, cannot be satisfactorily performed. The above experiments prove that the Petroleum Act of 1868 does not give sufficient and precise instructions for the testing of petroleum spirit. Therefore it is to be hoped that Government will again take the matter in hand, and do away with the objections of the present Act, substituting more clearly defined rules and instructions, to enable the operator to determine the flashing points of petroleum spirit with greater accuracy.

ON A

NEW STEP IN THE PROXIMATE ANALYSIS OF SACCHARINE MATTERS.*

BY JAMES APJOHN, M.D.,

PROFESSOR OF CHEMISTRY AND MINERALOGY IN THE UNIVERSITY OF DUBLIN.

The proximate analysis of crude sugars and syrups is a problem of practical importance, and also one of considerable difficulty, as such generally include not only cane sugar, but, in addition, two other varieties of saccharine matter—viz., inverted sugar, and crystallized glucose, commonly called grape sugar. The amount, indeed, of the cane sugar admits, as is well known, of being readily determined by an optical method, in which we may employ Soleil's saccharometer, the previous saccharometer of Biot, or the much more sensitive instrument for which the scientific world is indebted to Professor Jellett. By taking, with one or the other of these instruments, the rotative power on plane polarized light of the saccharine material under consideration, both before and after it has been inverted by digestion with an acid, we obtain data from which, and certain constants, the required information may be deduced. If, for example, separate solutions of the three sugars already named be made, containing 416 grs. in 10 cubic inches, the rotative powers of a column of each 20 centimetres (7·87 inches) long, when measured on the French instrument (with the use of which I am most familiar) are known to be—

For cane sugar.....	100°
" inverted sugar.....	36° at 59°
" grape sugar.....	76°

The rotative powers, therefore, of a single grain of each sugar made into syrup having the bulk already mentioned, and observed in the same tube, will be—

Cane sugar.....	0·240
Inverted sugar.....	0·086
Grape sugar.....	0·182

Hence, the observed rotation before inversion being θ, and after inversion θ', and x, representing the quantity of cane sugar, y, of inverted sugar, z, of grape sugar, we arrive at the two following equations, in which it will be noted that the rotation produced by the inverted sugar has a negative sign, and that the coefficient of inversion of the cane sugar is 0·36 (Jellett) at 59° F.

$$x \times 0{\cdot}24 - y \times 0{\cdot}086 + z \times 0{\cdot}182 = \theta \qquad (1)$$

$$-x \times 0{\cdot}24 \times 0{\cdot}36 = y \times 0{\cdot}086 + z \times 0{\cdot}182 = \theta' \qquad (2)$$

And subtracting the second of these equations from the first, we get—

$$x \times 0{\cdot}24 + x \times 0{\cdot}086 = \theta - \theta'$$

$$x = \frac{\theta - \theta'}{0{\cdot}326} \qquad (2)$$

Very important information is thus rapidly obtained, for the most valuable constituent of any crude saccharine substance is the cane sugar which it includes. But the analysis is imperfect, for we do not learn from it the quantity of either of the two other sugars, nor even their aggregate amount, for this cannot be got by subtracting the cane sugar already determined from 416 grs., as much of the difference is water, and in many cases *its* estimation cannot be accurately effected by any process of drying.

And here it may be observed, that by chemistry alone, and without any assistance from optical science, we can advance a step further than the saccharometer conducts us. We can, for example, reduce Barreswill's solution of copper with a syrup both before and after inversion. The latter experiment gives us the entire of the three sugars; the former, the sum of two of them, the inverted and grape sugar, while the difference of the results of the two experiments will correspond to the cane sugar. The chemical then goes a little beyond the optical method, for it not only tells us how much cane sugar is present, but, in addition, informs us of the exact aggregate amount of the two other sugars. Further than this it does not go; and we are still unable to assign the exact quantities of inverted and of cane sugar which may be present.

I have now to mention that, in conversing with Professor Jellett on this subject, he threw out the observation that, by combining the chemical and optical methods of experiment, the difficulty just alluded to might possibly be overcome, and the analysis rendered complete. Attaching much importance to his opinion

* From the *Transactions of the Royal Irish Academy*, vol. xxiv.—Science. Read December 13th, 1869.

on such a question, I turned the matter carefully in my mind, and soon found that his suggestion was quite correct, as will appear from the following explanation:—

By the optical method already adverted to, and with which physicists are long familiar, we obtain the quantity of the cane sugar; and by *inverting* the syrup, and applying it to the Barreswill's solution, we can get the entire amount of the three sugars, each being estimated on the hypothesis (we shall say) of its being grape sugar. The equations derivable from these two experiments are—

$$x \times 0{\cdot}24 - y \times 0{\cdot}086 + z \times 0{\cdot}182 = \theta \qquad (a)$$

$$x \times 1{\cdot}16 + y \times 1{\cdot}1 + z = w, \qquad (b)$$

the first being the equation, already explained, which gives the rotative power of the syrup; the second, that which expresses the amount, w, of the three sugars, which, after *inversion*, has been estimated by the *blue solution*. The numerical coefficients in the former equation are, as previously stated, the unit *rotation* powers of the respective sugars, while, in the latter, 1·16 is the ratio of the half atomic weight of cane sugar to that of the atom of grape sugar; and 1·1 is the ratio of the atomic weight of *inverted* to that of grape sugar. Now, as by the optical experiment the amount of the cane sugar, x, has been determined, the first term in each of the equations is known, so that, as there are now only two unknown quantities, y and z, the value of each may be determined.

I have applied this method, on several occasions, in the proximate analysis of crude sugars and syrups, and with satisfactory results. The details of a single experiment recently made will be sufficient here. In operating on the variety of molasses called *golden syrup*, its *rotative* powers, as given by Soleil's instrument, were found to be as follows:—

Before inversion.....	38·35°
After inversion.....	−12·15

Results from which we find, by equation (3) already given, the quantity of cane sugar in 416 parts of the syrup to be 154·95 grs. The second, or chemical experiment, was then made, which consisted in *inverting* 34·3 grs. of same syrup, and operating upon it with Barreswill's solution, which showed that the 34·3 grs. included 24·75 grs. of saccharine matter estimated as grape sugar, corresponding to 297·26 grs. from 416 of the syrup. Replacing, then, x, in equations (a) and (b) by its value, 154·9, and substituting in them 38·35 for θ, and 154·9 for w, they become—

$$154{\cdot}9 \times 0{\cdot}24 - y \times 0{\cdot}086 + z \times 0{\cdot}182 = 38{\cdot}35 \qquad (a)$$

$$154{\cdot}9 \times 1{\cdot}16 + y \times 1{\cdot}1 + z = 297{\cdot}26 \qquad (b)$$

These equations involve only two unknown quantities, and therefore admit of solution, and when worked out we find—

$$y = 70{\cdot}66$$
$$z = 39{\cdot}89$$

so that the final numbers at which we arrive are the following, the figures in column (1) referring to 416 grs. of the syrup, and those in column (2) being percentages.

	(1)	(2)
Cane sugar.....	154·95	37·17
Inverted sugar.....	70·63	16 95
Grape sugar.....	39·87	9 57
Water and other inactive matters.....	150·55	36·31
	416·00	100·00

The 36·31 parts set down as water are got by difference. I may, however, observe, that by the direct process of drying *in vacuo* over oil of vitriol only 22 per cent could be obtained, so that it is possible that some gummy matter may be present. Its amount cannot exceed 14·31 per cent, and it is probably much less, as the perfect expulsion of moisture from syrup is, as already observed, a thing very difficult of accomplishment.

I must not close this short paper without stating that the optical observation which gives θ' is one which it is difficult to make with the necessary degree of precision, for, though the syrup may be clarified by animal charcoal, in the process of inversion it invariably acquires a greater or less degree of color. Fortunately, however, it is not necessary to make any optical experiment on the inverted syrup, for the object of such experiment is to enable us to calculate the amount of the cane sugar, and this can be done in a different way. It is, in fact, quite sufficient, as already explained, to apply Barreswill's solution, not only after inversion, but before it; and the difference of the two results will correspond to the cane sugar present in the syrup. The equations which express the results of these two experiments are the following:—

$$\text{Before inversion, } y \times 1{\cdot}1 + z = w', \qquad (m)$$

w' being the grape sugar corresponding to y and z.

$$\text{After inversion, } x \times 1{\cdot}16 + y \times 1{\cdot}1 + z = w, \qquad (n)$$

w being grape sugar, corresponding to x, to y, and to z. From which we deduce—

$$x = \frac{w - w'}{1{\cdot}16},$$

In working upon this plan with 100 grs. of the specimen of molasses already mentioned, the following results were obtained:—

$$w' = 30{\cdot}64. \qquad w = 72{\cdot}87.$$

From which *data* we find—

$$x = \frac{72{\cdot}87 - 30{\cdot}64}{1{\cdot}16} = 36{\cdot}44,$$

a number approximating closely to 37·17, the percentage of cane sugar as determined by the saccharometer.

From equation (m), too, we learn that the inverted sugar multiplied by 1·1, with the addition of the grape sugar, amounts to 30·64 grs. But by the conjoint aid of the saccharometer and the blue solution, it has been already shown that $y = 16{\cdot}95$, and that $z = 9{\cdot}57$, so that $y \times 1{\cdot}1 + z = 28{\cdot}21$.

There is manifested here, it must be admitted, an appreciable amount of divergence; for, instead of the chemical and optico-chemical methods of assay being in harmony with each other, we find that a result given by the former exceeds the corresponding one given by the latter by 2·43 per cent. The cause of this discrepancy it is not difficult to assign. It must obviously proceed from the presence in the molasses of some principle or principles different from either cane, inverted, or grape sugar, and which themselves exercise circular polarisation, and, mayhap, also exert a reducing action on Barreswill's blue solution. The substances of this nature, which may possibly be associated with the sugars in saccharine juices, are dextrin, asparagin, and tartaric acids; and when any such do

exist in a saccharine product, its *exact* proximate analysis is rendered extremely difficult, if not impracticable. It is, therefore, scarcely necessary for me to state here that the optico-chemical process explained by me in this paper, will only give perfectly accurate results when applied to a mixture of cane, inverted, and grape sugars, in which no other *active* principle is contained. I may, however, add that the sugars just enumerated constitute the great bulk of all known saccharine products, and that, when other matters are present which complicate the problem, they are usually in such minute quantity as not to interfere materially with the success of my method when applied generally to the proximate analysis of saccharine products.

ON THE

ALLEGED SOLUBILITY OF GLYCERINE IN CHLOROFORM.

BY HARRY NAPIER DRAPER, F.C.S.

In Watts's "Dictionary" (vol. ii., p. 887), it is stated that "glycerine dissolves in all proportions in chloroform;" and, at p. 889, a process is actually quoted for the detection and estimation of cane-sugar and glucose in glycerine, based upon the assumption of this solubility. The same method (apparently quoted from the same source) is also given in the Chemical News (vol. viii., p. 227; *Eng. Ed.*).

It is not easy to conceive how Palm, who is the authority quoted by Watts for the analytical method, can have been misled by the somewhat easy *miscibility* of glycerine with chloroform to suppose that it was soluble in that body.

The following experiments were made with Price's glycerine, which had been kept for an hour at 136 C., and was then allowed to cool out of contact with the air.

(*a*). Equal volumes of glycerine and chloroform were shaken together in a graduated tube, and then allowed to rest. The two fluids completely separated, and their relative volumes were found to be unaltered.

(*b*). Ten c.c. of glycerine and 100 c.c. of chloroform were violently agitated together, and the mixture poured upon a filter moistened with chloroform. The liquid which passed through was then evaporated upon a water-bath. It left no residue.

(*c*). Experiment (*b*), repeated with boiling chloroform, gave an equally negative result.

I deduce from these experiments the conclusion that glycerine is absolutely insoluble in chloroform; and that, on the other hand, glycerine does not dissolve chloroform; and, as the chemical properties of all glycerines hitherto examined are alike, the statement in "Watts" must be considered incorrect, and the process of Palm as having no value.

Dublin, Feb. 15th, 1870.

ACTION OF

CHLOROSULPHIDE OF PHOSPHORUS UPON ALCOHOL.

BY M. CHEVRIER.

The only enquiries relative to this subject were made by M. Cloëz, who, in 1847, prepared sulphoxyphosphovinic acid, and several of its salts, and, ten years later, examined the action of $PSCl_3$ upon soda-alcohol, and obtained ethylsulphoxyphosphoric ether. His two notices are very short. The first contains no details of the secondary products of the reaction, which, moreover, is not formularised.

This subject has been my study, which was also extended to amylic alcohol.

The action of chlorosulphide of phosphorus upon alcohols is sufficiently complex; nevertheless, with care, it may be easily regulated, and the same products always obtained in the same proportions. (The only alcohols here alluded to are monatomic alcohols, corresponding with the fatty acids.) With the first terms of the series (methylic and ethylic alcohols), the action is very lively; but it is less so in the case of more distant terms—such as amylic alcohol. In all cases, the result is a compound acid—the chloride of the alcoholic radical, with evolution of chlorhydric acid, which may be easily collected, so as to allow of the reaction being formularised.

In the case of ordinary alcohol, the reaction is produced between 1 equiv. of chlorosulphide and 3 of alcohol.

$$PSCl_3 + 3\left.\begin{matrix}C_2H_5\\H\end{matrix}\right\}O = \left.\begin{matrix}(PS)'''\\C_2H_5\\H_2\end{matrix}\right\}O_3 + 2C_2H_5Cl + HCl.$$

By means of a special arrangement of the apparatus, all the chlorhydric acid and almost all the chloride of ethyl may be collected. The phenomenon is at all times more complex than the preceding equation would indicate; a small quantity of sulphur is precipitated, and a corresponding amount of ethylphosphoric acid is formed.

Ethylsulphoxyphosphoric acid is an oily liquid, heavier than water, which will not dissolve it, and having a nauseous odour. It is decomposed by dry distillation.

Soda-alcohol. The chlorosulphide, $PSCl_3$, reacts vigorously on soda-alcohol, and yields the corresponding ether discovered by M. Cloëz. All the chlorine of the $PSCl_3$ is fixed upon the sodium in the alcohol. The formula of the reaction is—

$$PSCl_3 + 3\left.\begin{matrix}C_2H_5\\Na\end{matrix}\right\}O = 3NaCl + \left.\begin{matrix}(PS)'''\\3(C_2H_5)\end{matrix}\right\}O_3$$

Ethylsulphoxyphosphoric ether is a colourless, oily liquid, insoluble in water, with an odour of rotten beet-root quite as disgusting as that of the corresponding acid. It can only be distilled in a current of steam.

Amylic alcohol. This may be slowly attacked at the ordinary temperature by chlorosulphide of phosphorus. The reaction is facilitated by stirring the mixture, to lessen the viscosity, and heating it in a water-bath. Abundant evolution of chlorhydric acid ensues, with formation of chloride of amyl and amylsulphoxyphosphoric acid. These two liquids are separated by heating the mixture to 105°. The residue is redissolved in alcohol, to separate the small quantity of sulphur, and then heated to 100°. The liquid thus obtained is oily, lighter than water (in which it is insoluble), and soluble in alcohol. It is decomposable by dry distillation at about 145°, but is easily distilled in a current of steam. One of its salts was prepared.

Alkaline amylsulphoxyphosphates and the baryta salt are very soluble in water. They are greasy to the touch, like all salts which contain the radical, C_5H_{11}, of amylic alcohol. The formula of the soda salt is—

$$\left.\begin{matrix}(PS)'''\\C_5H_{11}\\Na_2\end{matrix}\right\}O_3$$

That of baryta corresponds to—

$$\left.\begin{matrix}(PS)'''\\C_5H_{11}\\Ba_2\end{matrix}\right\}O_3 + Aq.$$

The copper salt is of a greenish-blue colour. It may

be used to prepare amylsulphoxyphosphoric acid, by treating it with a current of sulphuretted hydrogen. The crystals of amylsulphoxyphosphates produce very easily the phenomenon of epipolism. When thrown into perfectly pure water, they turn about like camphor until completely dissolved; the least trace of fatty matter will, however, stop the gyratory movement. Epipolic power was ascertained to be present in sundry crystals containing the radical amyl, particularly the sulphamylate of baryta: crystals of phenic acid are similar in this respect.

Amylate of Soda.—The action of $PSCl_3$ on amylate of soda is very energetic. The sodium alcohol is placed in a retort or spherical receiver, and the liquid added to it, drop by drop. The products of the reaction are then treated with water, which dissolves the chloride of sodium formed, and separates an oily liquid, which collects on the surface; this is amylsulphoxyphosphoric ether, a colourless liquid, which in time becomes slightly greenish. It distils in a current of steam, without decomposition. Its density at 12° is equal to 0·849. Its degree of refraction corresponding to the yellow ray of sodium is equal to 1·42. Reaction occurs between 1 equiv. of chlorosulphide and 3 of amylate of soda, as with common alcohol.

$$\left.\begin{matrix}(PS)''' \\ Cl_3+3\left\{\begin{matrix}C_5H_{11} \\ Na\end{matrix}\right.\end{matrix}\right\}O\Big)=\left.\begin{matrix}(PS)''' \\ (C_5H_{11})_3\end{matrix}\right\}O_3+3NaCl.$$

In the case of monoatomic alcohols represented by the general formula—

$$\left.\begin{matrix}C_nH_{2n+1} \\ H\end{matrix}\right\}O$$

the chlorosulphide of phosphorus gives the corresponding combined acid—

$$\left.\begin{matrix}(PS)''' \\ C_nH_{n+1} \\ H_2\end{matrix}\right\}O$$

the chloride of the alcoholic radical $C_nH_{n+1}Cl$ and of chlorhydric acid. Whilst reacting upon the metallic derivatives of these alcohols—

$$\left.\begin{matrix}C_nH_{2n+1} \\ M\end{matrix}\right\}O$$

the chlorosulphide $PSCl_3$ produces an ether analogous to the fatty bodies, represented generally by—

$$\left.\begin{matrix}(PS)''' \\ 3\,(C_nH_{2n+1})\end{matrix}\right\}O.$$

If the kind of decomposition to which chlorosulphide of phosphorus is subject in the presence of those simple or compound bodies upon which its action is exercised be carefully examined, it will be seen that its action is at the same time chlorising and sulphurising. The triatomic radical $(PS)'''$ has a remarkable tendency to substitution in compounds.

All oxygenated compounds which yield the oxychloride $POCl_3$ form corresponding sulphuretted compounds furnished by chlorosulphide $PSCl_3$. This liquid constitutes an excellent reagent for the substitution of sulphur for oxygen.

ON MICROSCOPICAL MANIPULATION.*

BY W. T. SUFFOLK, F.R.M.S.

(Continued from Amer. Repr., April, 1870, page 187.)

In the following lessons, the possession of an instrument fitted with Mr. Wenham's stereoscopic binocular arrangement has been supposed. As microscopes of moderate price are now so constructed, the author has no hesitation in arranging the following simple course of exercises more especially for its use; nearly all the observations can, however, be made with the monocular instrument.

The following tables, containing lists of the objectives made by the three principal London opticians, with their approximate magnifying powers and angles of aperture, may assist the student in selecting a glass suitable for the object to be examined. It must be borne in mind that the powers given are those of the lenses when used upon the stands of their respective makers; the length of the body materially influences the power of the combination, as will be seen by the table for the use of the draw-tube given in Messrs. Beck's list:—

R. AND J. BECK.

Focal length.		Linear Magnifying Power (nearly) with Eye-Pieces. 1	2	3	4	5	Angle of Aperture about
3 inches.	Draw-tube closed	12	20	40	48	74	12 degs.
	Do. if drawn out, add for each inch	2	4	6	7	10	
2 "	Draw-tube closed	20	38	70	85	130	18 "
	Do. if drawn out, add for each inch	4	6	8	12	15	
1½ "	Draw-tube closed	30	56	100	120	190	23 "
	Do. if drawn out, add for each inch	5	7	12	15	22	
⅔ "	Draw-tube closed	70	120	220	270	410	32 "
	Do. if drawn out, add for each inch	8	14	25	27	48	
4/10 "	Draw-tube closed	120	210	370	460	710	55 "
	Do. if drawn out, add for each inch	14	24	34	46	70	
4/10 "	Draw-tube closed	146	255	460	560	890	90 "
	Do. if drawn out, add for each inch	18	32	48	60	80	
¼ "	Draw-tube closed	200	340	590	720	1120	75 "
	Do. if drawn out, add for each inch	24	42	63	85	120	
⅙ "	Draw-tube closed	225	400	700	860	1450	85 "
	Do. if drawn out, add for each inch	18	35	60	80	130	
⅙ "	Draw-tube closed	225	400	700	860	1450	100 "
	Do. if drawn out, add for each inch	18	35	60	80	130	
⅛ "	Draw-tube closed	500	870	1500	1850	2800	120 "
	Do. if drawn out, add for each inch	60	100	180	190	370	
1/20 "	Draw-tube closed	900	1570	2750	3450	4950	140 "
	Do. if drawn out, add for each inch	80	150	300	350	900	

* The substance of a course of lectures delivered to the members of the Quekett Microscopical Club, January—April, 1869. This and the following articles contain such portions of the demonstrations after the lectures as could not conveniently be incorporated with the preceding text. Much new matter has also been added.

THOMAS ROSS.

Object Glasses.	Angular Aperture.	Magnifying Powers with the various Eye-Pieces.					
		A	B	C	D	E	F
5 inches	7 degs.	8	13	24	36	52	72
4 "	9 "	10	16	30	45	65	90
3 "	12 "	13	20	35	56	84	112
2 "	15 "	20	32	55	90	135	180
1½ "	20 "	25	40	70	112	168	224
1 "	15 "	37	60	105	170	255	340
1 "	25 "	37	60	105	170	255	340
⅔ "	35 "	60	100	145	270	405	540
½ "	90 "	95	153	265	420	630	840
4/10 "	110 "	140	220	370	650	975	1300
¼ "	100 "	195	310	540	850	1275	1700
¼ "	140 "	195	310	540	850	1275	1700
1/6 "	140 "	320	510	700	910	1360	1820
⅛ "	140 "	420	670	900	1200	1800	2400
1/12 "	170 "	600	870	1200	2000	3000	4000

POWELL AND LEALAND.

Object Glasses.	Angular Aperture.	Magnifying Power with the various Eye-Pieces.				
		1	2	3	4	5
2 inches	14 degrees	25	37	50	100	150
1½ "	20 "	37	56	74	150	220
1 "	30 "	50	74	100	200	300
⅔ "	32 "	75	111	150	300	450
½ "	70 "	100	148	200	400	600
4/10 "	80 "	125	187	250	500	750
¼ "	95 "	200	296	400	800	1200
"	130 "	—	—	—	—	—
"	145 "	—	—	—	—	—
1/6 "	100 "	250	370	500	1000	1500
⅛ "	140 "	400	592	800	1600	2400
1/12 "	145 "	600	888	1200	2400	3600
1/16 "	175 "	800	1184	1600	3200	4800
2/25 "	160 "	1250	1850	2500	5000	7500
1/50 "	150 "	2500	3700	5000	10000	15000

The screws cut upon the nozzles of microscopes, and upon object-glasses, are now common among English opticians, so that the objectives may be attached to any stand at pleasure.

The following symbols will be employed to indicate the apparatus to be used.

Object-Glasses—

4 in. or 3 in.	.....	O3
2 " 1½ "	.....	O2
1 " ⅔ "	.....	O1
½ " 4/10 "	.....	O½
¼ " 1/6 "	.....	O¼

Higher powers, O, with the fraction indicating the nominal focal length.

Eye-Pieces.—When no symbol is used, the lowest power, viz., No. 1, or A, is supposed; medium power, E 2; deeper, E 3; return from deep eye-piece to one of lower power, E.

The binocular prism is supposed to be employed in general; when it is to be withdrawn, and the instrument rendered monocular, M is used; the return to the binocular is indicated by B.

The illuminating apparatus first mentioned is that to be used if possible; that following, between brackets, may be used as a substitute.

The apparatus and materials constantly required, besides the microscope, are—

A Lamp (vol. xx., p. 158).—A glass stage-plate; easily made by attaching a narrow slip of glass, with marine glue (vol. xx., p. 171), to a glass plate of convenient dimensions, so as to form a ledge, and prevent objects slipping off when the stage is inclined.

Some 3 × 1 slides; a small stock of thin cover glass, in squares and circles; forceps; needles mounted in handles (vol. xx., p. 182); a few pipettes (vol. xx., p. 170), and some blotting paper; a small quantity of alcohol and turpentine; and also a supply of water should be at hand.

The following books, being often referred to, will be quoted with abbreviated titles:—

Carpenter.—"The Microscope and its Revelations," by W. B. Carpenter, M.D. (4th edition, 1868.)

Beale.—"How to Work with the Microscope," by Dr. L. S. Beale, F.R.S. (1868.)

Hassall.—"Adulterations Detected," by A. H. Hassall, M.D.

LESSON I. ON THE USE OF THE CONDENSING LENS AND MIRROR.

Material for Examination—White Blotting-Paper.

Arrange the microscope at a comfortable inclination, and adjust the draw-tubes of the eye-pieces to suit the distance between the eyes. Screw on the objective, O1; in doing this, hold the glass within the nozzle of the microscope with the first and second fingers of the left hand, while it is screwed in with the finger and thumb of the right. Do not leave go with the left hand until the screws have good hold; observe the same precaution in unscrewing; never risk the fall of an object-glass.

Tear with the forceps (not cut) a minute fragment from the edge of a piece of blotting-paper; place it upon the glass stage-plate, and bring it, as nearly as can be judged, under the centre of the object-glass, which should be well raised above the stage. Place the lamp on the left of the microscope, at a height about half way between the stage and eye-piece, and direct the light upon the paper with the condensing lens (vol. xx., p. 159; *Am. Repr., Dec.* 1869, *page* 323). Bring the object-glass down, by means of the coarse adjustment, nearly to the working distance of the objective; this is always considerably shorter than the nominal focal length; with O1 it may be a little more than half an inch. After a little practice, the student will learn the proper distance for each glass; until this is acquired, it is best to proceed cautiously, to avoid injury to the object, especially when high powers are used.

Now look through the instrument; adjust the position of the object, with the fingers or stage movements, until it occupies the centre of the field; bring it accurately into focus with the coarse adjustment; and alter the position of the condensing lens and of the lamp, if necessary, so as to obtain the most perfect illumination.

The paper will be found to consist of interlaced fibres, which are seen to the best advantage at the edges, where they are frayed out; hence the direction to tear. This applies in numerous cases, a laceration or fracture sometimes revealing points of structure in a manner not easily demonstrated by other means.

When the object has been fully examined, remove the condenser, open the large aperture in the wheel of diaphragms beneath the stage, lower the lamp upon its stem into a convenient position for lighting the concave mirror, and direct the convergent pencil upon the object. It will be found that the view now ob-

tained is in every respect inferior to that by reflected light; this is owing, partly to the opacity of the paper, and partly to the different densities of the object and of the medium in which it is viewed. If a higher power, O¼, M, is used, the result will be much worse; this kind of view is that obtained by beginners, who usually try to examine every object by transmitted light and but rarely use other and better means of illumination. Change the power to O1, B; place a drop of water on the object with a pipette (or the tip of the finger); cover with a thin glass; absorb any surplus moisture with blotting-paper; replace the slide on the stage; and adjust the focus. The confused appearance of the edges has now disappeared, and the light to some extent penetrates the central portions of the object. With the binocular, the full light from the mirror will be found to produce an unpleasant glare, and the white cloud illumination (vol. xx., p. 265; *Am. Repr., Feb.* 1870, *page* 53) may be substituted with advantage. Still, little beyond the fibres at and near the edges can be well made out. Remove the slide from the stage; take off the cover, and with a pair of mounted needles tear up and spread out the moistened paper; replace the cover, and examine as before. All the structure will now, probably, be seen; if not, tear the object up still more, until the result is satisfactory. Higher powers may now be used with advantage, taking care to make the requisite correction for the aberration caused by the cover glass (vol. xx., p. 169; *Am. Repr., Dec.* '69, *page* 324), should the objective be provided with the proper adjustment. With the glasses O½, O¼, and higher powers, it will be desirable to employ the fine adjustment in completing the focussing, and during the observation. Until the beginner has had some experience, it will be best to use O½, in preference to a higher power, as the risk of damaging the object, or object-glass, is lessened; after a time, the use of glasses of short working distance will become easy. In removing a slide from the stage when a high power is employed, raise the body to some distance, to prevent accidental contact with the front lens, as it might be scratched or otherwise injured.

Try the effect of viewing some more torn up fragments in other media, such as oil, turpentine, or glycerine. Mount a specimen in balsam (vol. xx., p. 207; *Am. Repr., Dec.* 1869, *page* 329), taking care that the paper has been well saturated with turpentine, to remove air bubbles.

These experiments may be repeated with other kinds of paper, and their different degrees of compactness noticed. The determination of the material of which the paper is composed had better be deferred until Lesson VI. has been studied.

Arrange the microscope and lamp for the use of the condensing lens; as before, use O1, B; make a few marks, with a soft black-lead pencil, on a piece of blotting-paper, and notice the disposition of the particles of plumbago among the fibres. Examine ink marks; printing from plate (a visiting card will do); likewise specimens of surface-printing, as wood engraving or type, and also lithographs. Notice the varying manner in which the ink is distributed.

Repeat the experiments with the light on the right hand, and also in front. Although it is most convenient to place the lamp on the left, because it is out of the way of the right hand moving and adjusting the object in the stage, yet it may sometimes be required to place the light elsewhere; and the student should be able to work with it in any situation. Practice by daylight should not be neglected whenever opportunities offer.

Try, also, the effect of using different eye-pieces. When a complete series of objectives is not at hand, an awkward interval of magnifying power may often be thus filled up (see Tables, vol. xxi, p. 89; *Am. Repr., May*, 1870, *page* 233). In drawing, it is often useful to make the object till the field; this can generally be done by a suitable change of eye-piece.

Lesson II.

Material for Examination—Dirt from Sponges.

This can be obtained in any quantity from dealers. It accumulates at the bottom of the boxes in which sponge is imported.

Arrange the microscope as in the former lesson, O2, Illuminator. Parabolic Lieberkuhn or [*Condensing-Lens*].—If artificial light is used, render the rays parallel (vol. xx., p. 255) before they are reflected from the lieberkuhn.

Spread a small portion of the substance over the stage-plate.

The specimen will most likely be found to consist chiefly of sand, which prevents a good view of the other substances in it being obtained, although, here and there, some objects may be seen. The sand may be removed by sifting through a piece of wire-gauze, of about 40—50 threads to the inch; or a series of sieves may be used, if it is wished to carry out the sorting to a greater extent. Examine some of the coarse residue as before. The principal contents will be coarse sand and fragments of rock, fibre, abraded splinters of wood, seaweed, fragments of *Echinus* spines, skeletons of various *Hydrozoa* and *Polyzoa* (vulg., *Zoophytes*), sponge, spicules, and shells.

Separate the shells and other objects that may be required for further study; this may be done by picking them up with a small camel-hair pencil, moistened and drawn to a point. Small pill-boxes or homœopathic-bottles make convenient receptacles for keeping these objects in, when sorted. A pocket-lens mounted on a stand, or a watchmaker's glass will afford sufficient magnifying power. If the light is concentrated upon the substance to be examined with the condensing-lens, and black paper used to spread the sand on, a great deal may be done without using the glass at all. For dissecting and more delicate operations of this kind, Beck's 3-inch binocular magnifier will be found useful: it is, in effect, a pair of achromatic spectacles of considerable power, and fatigues the eyes less in prolonged operations than the use of a single lens. A more complete binocular dissecting is described in "Carpenter," p. 54.

Select some of the shells resembling small nautili (*Foraminiferæ*), and make arrangements for examining them in varied positions with Disc-holder (vol. xx., p. 193) or [*stage-forceps*]. Observe the peculiar structure of the part where the mouth of an ordinary univalve-shell (*Gasteropoda*) usually is, closed with a perforated plate, instead of being open. Also, in some species, perforations will be observed on the sides of the shells: hence the name of the group *Foraminiferæ*. Mount some of the shells dry in various positions (taking especial care that the mouth is well displayed), label, and preserve for reference.

Bed some of the shells in balsam (vol. xx., p. 208), and grind away the surface so as to expose the interior; carefully polish, and remove the balsam. This

process will reveal the chambered internal structure, which varies extremely in different species. An increase of power may now be used with advantage (O1, or O½ if the illuminator for this higher objective is accessible). With such augmented power, the minute shell-structure may be observed; but this can be accomplished more readily by grinding a thin section, which will admit of examination with higher powers and the paraboloid or achromatic condenser. These thin sections can be ground by a process devised by Dr. Wallich (*Ann. Nat. Hist.*, July, 1861; also "Carpenter," p. 192, note). The shell is to be fastened to a thin plate of mica, in the first instance, and this, with the shell upwards, is to be cemented to the plate of glass on which it is held during the process. One side is ground and polished in the usual manner. The slide is then warmed, which permits the removal of the mica plate with the half-finished section attached. The shell is then cemented by its polished side to another grinding-plate, and completed in the usual manner. The plate of mica is easily ground away, and offers no impediment to the cutting of the shell. The resulting section is to be mounted, either dry or in balsam, as circumstances may require.

Foraminiferæ and other shells abound in deep-sea soundings. As usually obtained from this source, they are mixed with the tallow placed at the bottom of the lead to bring up the sample; this grease must be removed by solution in benzol. *Foraminiferæ* and other fossils may be separated from chalk by processes described in Lesson 3.

For further information respecting the *Foraminiferæ*, see art. *Foraminiferæ*, "Micrographic Dictionary," p. 292; "Carpenter," pp. 482—523; Greene's "Manual of the Protozoa"; Williamson and Carpenter's Monographs (Ray Society).

Lesson III.

Specimens Required.—Flour, Starch (Arrow-root, Potato-Starch, or Brown and Polson's Corn Flour), Chalk (in Lump, not Whiting or Washed Chalk), Powdered Lump-Sugar, and Common Table-Salt.*

Examine by placing a minute quantity of each of these white powders on the stage-plate, and examine with O1, by reflected light, as in preceding lessons. Notice the different appearances of each. The flour will be found to contain numerous rounded, glittering bodies (starch granules), mixed up with a quantity of matter not easily defined with the power employed. The starch consists entirely of these shining substances, which, in the larger kinds, as "Tous-les mois," cause a distinct glittering appearance without any optical aid, if examined in a good light. The chalk is apparently structureless. The sugar and salt exhibit numerous crystals, more or less broken.

The student will do well to examine the solubility of these substances, by shaking a little of each in a test-tube, with water. Small portions should also be heated to redness, on a slip of platinum foil, in the flame of a spirit-lamp. The flour and starch will be carbonised and burnt to an ash, if the heat is long continued. The chalk will still remain white. The sugar will melt, and then carbonise. The salt will decrepitate or crackle, and bound off the platinum.

These simple chemical examinations should not be neglected by the microscopist, especially when examining unknown substances. Some skill in the use of the blowpipe may occasionally be of service. Solubility of a substance in water or other fluids may be tested under the microscope, and with the advantage that very small quantities are sufficient for experiment. Other reagents may also be employed. "Beale," p. 201.

Flour and Starch.—Place a little of the starch and flour on separate slides, with a drop of water; stir up with the point of a knife or needle, to diffuse the particles; cover with thin glass, and view with same power, first with dark-field illumination, and afterwards by transmitted light. Then use O¼M by transmitted light. The flour will be seen to consist of the before-mentioned rounded bodies, with a small admixture of fragments of membrane, cell, wall, &c. These are best seen in meal made by crushing or grating a grain of corn, as flour in general is too finely sifted to contain much of these textures. The slide of starch will exhibit the same rounded bodies, starch granules. They are best studied in a large-grained kind, such as *Tous-les-mois,** the product of *Canna edulis*. With O¼M and transmitted light, a number of concentric rings will be seen, surrounding a spot known as the *hilum*. Microscopists differ respecting the nature of these markings (see article *Starch*, "Micrographic Dictionary," p. 657; "Carpenter," p. 399). Examine with *polariscope* O1, and, if possible, with higher powers. Notice the characteristic black cross, having its centre at the hilum. In oat-starch the black cross is wanting, the grains are polygonal, and clustered in rounded masses. Test the contents of the slides with a solution of iodine in water, made by placing a small crystal in distilled water. When it has acquired a straw colour, it will be of sufficient strength; only a minute quantity will be dissolved. A small drop of this reagent is to be placed at the edge of the cover with a pointed pipette, or, better, with one of the test-bottles with perforated conical stoppers. When the iodine reaches the starch granules, they will be stained of a violet colour. This and the polarisation test will readily distinguish starch granules from other round bodies. A series of starches from various plants should be mounted, and kept for comparison. Two slides of each should be prepared, one dry, the other in balsam, for examination with the polariscope. When starch is mounted in balsam, care should be taken to employ as little heat as possible. Starch granules are not well preserved in fluids. Starch may be separated from flour by making it into a stiff paste, tying it in a muslin bag, and kneading in water. The gluten will be left in the bag, and the starch will fall to the bottom of the vessel, and can be cleaned by washing and decantation of the supernatant fluid. Roots, &c. (as potatoes and carrots), can be crushed or grated, and the starch washed out, cleaned, and collected. Starch may be viewed *in situ* by cutting thin sections of potato. These may be dried by the ether process (vol. xix., p. 194), and some mounted dry, and others transferred to benzol, and then mounted in balsam.

* This is a very cleanly prepared *maize*-starch, which may be used for nearly every purpose where arrow-root is required. It would be well if manufacturers would call things by their right names. The term "flour" is likely to mislead; it means something quite different. Corn-starch or maize-starch would be more suitable.

* *Tous-les-mois* can be obtained of Messrs. Fortnum and Mason; also *genuine* arrow-root and other materials, which can be depended upon for use as standard samples.

[English Edition, Vol. XXI., No. 537, page 114; No. 538, page 125.]

Starches from various sources, and the structure of wheat, barley, and other kinds of grain, are accurately figured in "Hassall," pp. 242—256 and 314—321.

The student should make accurate outline sketches of all the starches examined, with the camera-lucida or tinted reflector, selecting, in each specimen, the largest and smallest granules, and also some of intermediate size. A scale should be drawn on the paper from the micrometer. The shape and dimensions of starch granules and other similar objects are readily compared from such drawings, and with far greater facility than from lists of micrometric figures.

Chalk.—Scrape a small portion of the chalk upon a slide. Place upon it a drop of water, stir it up, allow the larger particles to subside, and then gently tilt the slide, so that the water may run down, and carry with it the lighter particles. Absorb the surplus wet with blotting-paper, dry cautiously over the lamp-chimney, and mount in balsam.

Examine with $O\frac{1}{4}$, or [O1, E2 or 3] black-field illumination, with Parabola or [*spotted-lens*]. If the preparation has been successful, *Foraminiferæ* may be distinguished among some of the particles. It is well to make two or three preparations, in case of failure.

To obtain the shells, sponge-spicules, &c., separately, it will be necessary to break up the chalk. This is best effected by boiling in a solution of sulphate of soda, made strong enough to crystallize on cooling: on this taking place, the chalk will be found to be disintegrated (Quekett's "Lectures on Histology," vol. ii., p. 80). Sufficient water should then be added to dissolve the crystals, the mixture agitated, and the chalk allowed to settle. The fluid should be decanted, the vessel again filled up with water, and decantation repeated before the finer particles have subsided. By continuing this process, if carefully managed, the shells will be obtained, eventually, nearly or quite clean. The washings should be allowed to settle, and be examined with the microscope, to ascertain whether they contain any of the smaller fossils. The shells may be mounted dry or in balsam. The result will vary according to the locality from which the chalk was obtained.

Another very efficient process, by Mr. E. H. Robertson, will be found in *Science Gossip*, vol. iii., p. 36.

If the sponge-spicules and siliceous fossils only are required, they can be obtained by dissolving the chalk in dilute hydrochloric acid.

The coarse matter left after chalk has been washed for the purpose of making whiting is, when it can be procured, a good material to operate upon, as it is much richer in minute fossils, which are left in the heavier portions of the chalk.

The *Polycystinæ* may be obtained from the "Barbadoes-earth," by a process fully described by S. Furlong, *Quarterly Microscopical Journal*, Jan., 1861; also quoted by Davies, in "Mounting Microscopic Objects," p. 64.

Sugar and Salt.—The preliminary examination has already shown that these two substances differ materially in appearance from the others with which they were compared. While they exhibited none of the organised structure of the flour and starch, yet the difference between them and the chalk was very marked. They presented, when not too much crushed, traces of a certain regularity of form, which was entirely absent in the latter mineral. The condition of both the sugar and salt was very unfavourable for the study of these regular forms, which are known as crystalline. For further examination, it will be necessary to procure uninjured specimens.

Well-formed crystals may generally be found in most samples of good moist-sugar: a few of these are to be mounted in balsam, for examination. Sugar is rather difficult to crystallise in the small way, the general result being an amorphous film on the slide. For a very full account of sugar, see "Hassall," pp. 181—198.

Crystals of salt are easily obtained. Make a strong solution in distilled water, by boiling in a test-tube, and filter while hot. A drop of this fluid, placed upon a slide, will soon deposit a number of cubic crystals. These and the sugar-crystals may be viewed with a low power, O2, and dark-field illumination, by means of the Parabolic Reflector or [*spotted lens*]. This mode of lighting is very useful in such examinations, as it aids considerably in estimating solidity. Beyond regular mathematical form, no structure is to be observed in these bodies. *Polarised light*, however, renders certain optical peculiarities apparent.

Arrange the microscope for the use of the polariscope: it will then be seen that the crystals of salt are not at all affected by the altered illumination, and this is the case with all crystals belonging to the cubic system: crystals of potash-alum will supply another example. Let the sugar now be examined in the same way: it will be found, upon rotating the analyser or polariser, that they either become coloured or, when the field is darkened, remain luminous. If the thickness of the crystals is not adapted to produce colour, the use of a suitable selenite film will assist in obtaining it. It is here evident that polarised light reveals something which we should not be aware of without its aid: it supplies the means of determining whether a crystal possesses the property of double refraction or not.

The forms and colours of many crystals are extremely beautiful, and a collection is very easily made. As a long list will be found in "Carpenter," p. 773, only a few salts will be mentioned here.

Make a hot saturated solution of sulphate of copper. If a drop of this warm solution is placed upon a slip of glass, and examined at once,* long crystals, with sloping ends like a turner's chisel, will be seen shooting out from the edge, which will eventually cover the centre. If a small quantity of nitrous ether be added to the solution, a number of the crystals will be obtained in the form of separate rhomboids, which will shine like richly-coloured gems on the black field of the polarising microscope. Both slides, when dry, should be mounted in balsam, and labelled.

Some curious phenomena attending the crystallisation of sulphate of copper are described by Mr. R. Thomas in the *Quarterly Microscopical Journal* (1866, p. 177). An abstract of the paper, with figures, will be found in "Beale," p. 214.

The crystals of salicine are very easily made, and are very good examples of radiating crystals. A saturated solution in distilled water is to be made, and a drop, placed on a carefully-cleaned slide, is to be evaporated over the lamp until it dries into an amorphous mass. Upon cooling, a number of circular groups of crystals will generally be formed; this may be aided by breathing on the slide, the moisture often inducing the formation of the crystals. When sufficiently developed, the process should be stopped, by gently heating over the lamp-chimney, and mounting at once in balsam.

* For this purpose, the microscope must be placed vertically, to prevent the fluid running off the slide, as the observation is best made without a cover. The instrument should only be used in this position when absolutely necessary, as it is uncomfortable and inconvenient.

An account of the mode of making the beautiful flower-like crystals of sulphate of copper and magnesia is given in "Mounting Microscopical Objects," by T. Davies, p. 76.

Lesson IV.

Structure of Wood.

With the point of a sharp knife, split, *not cut*, thin splinters from a lucifer match or piece of deal. Suitable fragments may often be found at the bottom of a box of matches. Examine with O1; illuminate with Parabolic Lieberkuhn or [*condensing lens*], using Disc-Holder or [*stage forceps*] as a support. The splinter will exhibit a fibrous structure, varying in character according to the direction of the split. The simplest structure in this specimen is the cellular tissue crossing the woody fibres; these lines of cells run from the centre of the stem to the circumference, among the fibres and ducts, keeping up a communication between the centre and the growing portion between the wood and the bark, known as the *cambium layer*. The sides of the woody fibres are, in deal, covered with rows of dots, which are characteristic of the *Coniferæ*, although they are found in the woody tissues of some few other trees. To see these well, a higher power will be required, O½, and Parabolic, or [*spherical lieberkuhn*], and to secure the most favourable position for observation the disc-holder will be found convenient.

To thoroughly investigate the structure of wood, three sections are necessary, one across the stem and two in a longitudinal direction. For the purpose of study, where large and fine specimens are not required, the use of a section machine may be dispensed with, as small sections in any direction may easily be cut with a sharp knife or razor.

The transverse section shows the general arrangement of the tissues composing the stem, consisting of a concentric arrangement of fibres and vessels, of which the cut ends only are seen in this section; the concentric rings represent periods of growth, and usually, but not always, correspond with the number of years the stem has been forming; the *medullary* rays are seen running from the pith in the centre to the circumference—they are developed to an enormous extent in the Clematis, where their grouping in masses gives a marked character to the transverse section.

The other two sections are longitudinal, and are cut, one parallel to the medullary ray and the other across it. The first, or *radial section*, exhibits the sides of the medullary rays; the second, *tangential section*, their cut ends; these are very conspicuous in mahogany.

The structure of the stem of endogenous plants differs considerably from that of exogens, just described; in these, there is no very marked distinction between wood and bark—the rings of annual growth and the medullary rays are wanting, so that a single longitudinal section only is required, instead of the two needed to demonstrate the structure of an exogen (a section of cane will supply a good example). For the histology of plants, see Bentley's "Manual of Botany," Book I. There are many very accurate figures of vegetable tissues throughout Hassall. The knowledge of the minute structure of plants is of the greatest use to the analytical microscopist, as it is by this means alone that mixtures of vegetable powders can be detected. Full details are given in Hassall.

Sections of woods, such as ebony, box, and some others, which are too hard to be cut in the usual manner, may be obtained by grinding, as in the case of bone; this process must also be adopted with cellular tissue, when hardened by deposits of sclerogen, as cherry and plum stones, ivory nuts, cocoa-nut shell, and many other hard substances. Soft substances, as leaves, may be cut by being pressed between two pieces of cork, which are sliced with it. Cellular tissue like that of the common rush, which yields so much to the knife that it is pressed aside instead of being cut, should be saturated with melted wax before attempting to make a section; this can be removed from the thin slices with benzol.

(To be continued.)

GALVANOSCOPIC LANTERN.

BY EDWIN SMITH, M.A.

Having occasion to exhibit to an audience some of my recent experiments on the electrical phenomena of plants, I was obliged to invent some means of throwing the image of the index of a sensitive galvanometer upon a screen. I did not want to use the electric light, or to add the weight of even a small mirror to the astatic needles; otherwise a bright spot of light might have been made to indicate the deflections on the plan of a Thomson's galvanometer. After a good many trials of various expedients, I hit upon the following, which I found to answer my purpose admirably. It is an application of the principle of the magic lantern, and is at once simple and effective. It requires no stronger light than that afforded by a large belmontine lamp. The hands of the operator, not being wanted for troublesome adjustments of the illumination, are at liberty for the performance of his experiments. The apparatus is also inexpensive. No iron must, of course, enter into its structure; I made mine of wood, with brass screws, only adding a copper chimney to the box which contained the lamp. The light thus enclosed is placed in the focus of a large condensing lens. A circular aperture is left in the lamp-box of the same size as the lens for that purpose. The rays, being made parallel by the condenser, fall upon a mirror behind, sloped at an angle of 45°, and are thus thrown upwards past the moving index of the galvanometer. This index, formed of the lightest possible stem of grass, is fixed at right angles to the upper needle, and projects horizontally over the lower mirror before mentioned. Just above the index, and in the top of the box, are placed the front lenses of a magic lantern, which throw divergent rays upon a second mirror, also inclined at a suitable angle, by which they are finally cast upon the white screen. It is best to adjust the lower mirror first with regard to the light, then to adjust the sliding lenses, till a distinct black image of the index is obtained stretching across a bright field. The front and the back of this apparatus may be made movable to enable one to get at the interior when necessary. An upright narrow case of cardboard, strengthened by two parallel ends of wood, should be placed so as to contain the arrangements for suspending the needles, and prevent gusts of air from disturbing them. Two mercury cups may be drilled behind the box in the thick board which forms its bottom, and which should project beyond the sides for the purpose of carrying three or four levelling-screws. Every part of the box, inside and outside, must be stained black.

I can strongly recommend the above contrivance to the notice of teachers and lecturers. A popular audi-

ence seems to understand the clock-like movements of a black finger upon a screen more readily than the linear motions of a bright spot. The spectators feel as if they saw the needle itself which is being deflected by voltaic currents.

ON THE

ESTIMATION OF THREE KINDS OF SUGAR IN ONE SOLUTION.

BY A. DUPRE, PH.D.,

LECTURER ON CHEMISTRY AT WESTMINSTER HOSPITAL.

For some years past, I have been constantly in the habit of estimating two, and sometimes three, kinds of sugar present in one solution, by the conjoint use of the chemical and optical methods. The plan adopted by me differs from that of Professor Apjohn described in the Chemical News (vol. xxi., p. 86; *Am. Repr., May*, 1870, *page* 230), and, I believe, solves the same problem in a more direct manner. This problem is the estimation of cane, grape, and fruit sugar, when present in the same solution. Invert-sugar is a mixture, or compound, of fruit and grape sugar in equivalent proportions, and its amount can therefore readily be calculated if the amount of these two sugars be known.

Now, cane-sugar does not reduce the cupric solution, and is not affected by heating with a dilute solution of caustic alkali. Both grape and fruit sugar, however, reduce the cupric solution, and both are readily destroyed by being heated with a solution of caustic alkali. We can thus estimate the amount of cane-sugar, by its rotative power, having previously destroyed the grape and fruit sugar; we can estimate, chemically, the aggregate amount of these last two sugars, quite independently of the presence or absence of cane-sugar. We have now only to estimate the amount of rotation due to the three sugars jointly, and are then in possession of all the necessary data for the quantitative estimation of each.

It will be seen that the cane-sugar is estimated by direct observation; and the problem thus, in reality, resolves itself into the estimation of a mixture of grape and fruit sugar. The amount of rotation produced by these two being estimated directly, if cane-sugar be absent; indirectly, in the presence of cane sugar, by subtracting the rotation due to the cane-sugar from the rotation produced by the three sugars jointly.

The instrument employed by me (one of Professor Jellet's beautiful saccharometers) has a 10-inch tube, in which a solution containing—

1 per cent cane-sugar, required for compensation 0·2418 inches left-handed turpentine.

1 per cent fruit-sugar, required for compensation 1·502 inches of a 10 per cent cane-sugar solution.

1 per cent grape-sugar,* was equivalent to 0·836 inches of 10 per cent cane-sugar solution.

Now, let x be the amount of fruit-sugar sought; let y be the amount of grape-sugar sought; let p be the sum of both sugars found by the cupric solution expressed in percentages; and let a be the number of inches of 10 per cent cane-sugar solution which has been found to compensate, or be equivalent in rotating power to, the mixture p of fruit and grape sugar present.

We have then the equations—

$$x+y=p$$

$$x\times 1{\cdot}502-y\times 0{\cdot}836=\pm a$$

and

$$x=\frac{p\times 0{\cdot}836\pm a}{2{\cdot}338}$$

$$y=p-x$$

As regards a, the sign + is taken if the mixture of the two sugars turns to the left, and requires to be compensated by the cane-sugar solution; the sign −, if the mixture turns to the right; in which case a represents the number of inches of 10 per cent cane-sugar solution equal in rotative power to this mixture, as estimated by the left-handed turpentine, calculated, of course, in either case, for the 10-inch tube.

I have employed the foregoing method only for estimating the amounts of these three sugars present in wines, but it is, no doubt, equally applicable to crude sugars and syrups.

* I have throughout taken grape-sugar dried at 100°, when its composition is $C_6H_{12}O_6$, the same as fruit-sugar.

THE WATER-TYPE.

BY J. ALFRED WANKLYN.

The following propositions are, I believe, admitted generally at the present time:—

(1). That the oxy-salts of the metals are built on the water-type, and consist of acid-forming radical and metal, bound together by one or more atoms of oxygen.

(2). That an acid is a salt wherein hydrogen plays the part of the metal, being bound by means of oxygen to an acid-forming radical; and that, in like manner, an alkali is a structure wherein hydrogen is bound by oxygen to a metal.

(3). That double decompositions between salts, or between salts and acids or alkalies, or between acids and alkalies, consist in exchanges of one metal for another metal, or for hydrogen. Thus the double decomposition between sulphate of potash and nitrate of baryta is commonly regarded as consisting in an exchange of potassium for barium, whereby sulphate of baryta and nitrate of potash are produced. The same result may be conceived as being produced by the exchange of sulphuryl for nitroxyl (NO_2)$_2$; but chemists do not usually refer these double decompositions to displacements of the acid-forming radicals. The nomenclature which is in use favours the one mode of representation and discourages the other. Thus, keeping to the example above given, chemists of the present day write sulphate of potassium, or potassic sulphate or potassium sulphate and nitrate of barium, baric nitrate or barium nitrate; names which suggest the view that double decomposition takes place by exchange of the metals. The terms potassate of sulphuryl and bariumate of nitroxyl (names which would point to exchange of acid-forming radicals as the *modus operandi* of double decomposition) have, so far as I know, never been proposed by any one.

As may be gathered from his recent papers, the author of the present notice is prepared to offer other modes of representation, in place of those which have just been set forth, and which are in vogue at the present time.

Instead of looking upon the oxy-salts of the metals as consisting of acid-forming radical and metal held together by oxygen, it is proposed to consider them as

being structures wherein oxygen and acid-forming radical are held together by the metal. Thus, quoting from a former paper, acetate of soda is regarded as the following:—

$$Na''' \left\{ \begin{array}{l} O'' \\ (C_2H_3O)' \end{array} \right.$$

And it should be understood that the considerations which have been urged for the metal sodium and its compounds are taken as being of extensive application, and, with slight modifications, as applicable to the metals in general.

The analogy between acids and metallic salts the author of this notice denies. That the acids are built on the water-type he is, indeed, not prepared to deny; but he maintains that the acids and the metallic salts are built on totally different types. The alkalies, instead of being waters and being like the acids in structure, are like metallic salts. Thus caustic soda is—

$$Na''' \left\{ \begin{array}{l} O'' \\ H \end{array} \right.$$

Double decompositions between metallic salts, or between salts and acids or alkalies, or between acids and alkalies, are exchanges of one acid-forming radical for another, or for hydrogen. Such, then, is the contrast between that which is generally received by chemists and that which is proposed as a substitute for it.

These opposite modes of representation are, as a little reflection will show, embodiments of fundamental notions respecting the analogy, or want of analogy, between hydrogen and metals.

The one which is generally in vogue expresses resemblance between hydrogen and metals.

The other, which is proposed, expresses dissimilarity between hydrogen and metals.

Is there, then, as a matter of fact, fundamental analogy, or fundamental want of analogy between hydrogen and metals?

In endeavouring to arrive at a just conclusion on this point, it will hardly be proper to omit mentioning the very obvious facts of the extreme physical dissimilarity of hydrogen to the metals. Whilst hydrogen is the lightest known gas (not liquefied by any degree of cold or of pressure hitherto applied to it), there are metals which figure as the heaviest known solids, and there are metals which have hardly been fused; and all, save one, are solids, under ordinary conditions. There is, moreover, a total want of continuity of physical properties between hydrogen and metals. In volatility, the metal next to hydrogen is mercury; but there is an immense gap between a substance which has not been liquefied and a substance which, like mercury, only ceases to be liquid at 360° C.

The extreme eagerness with which chemists seize upon the faintest shadow as a pretext for assigning to hydrogen the faculty of existing in a condensed state is, to my mind, evidence of the great importance instinctively allowed to the vast physical dissimilarity between hydrogen and metals which are next of kin to hydrogen, according to popular chemical belief.

The facts of the vapour-densities of hydrogen-compounds, and of such metallic compounds as have been investigated in this direction, reiterate the same tale of dissimilarity.

In the standard two volumes of hydrochloric acid gas, there exists only one volume of chlorine; but, in the standard two volumes of chloride of mercury vapour, or chloride of aluminium, or chloride of iron, there are more than one volume of chlorine. The vapour-densities of organo-metallic bodies, moreover, all exhibit more than one volume of organic radical in the standard two volumes of vapour. Up to the present time, no metallic compound has been found to exhibit a vapour-density which should entitle it to figure as a representative of hydrochloric acid gas.

These facts have already exercised a part of their legitimate sway over the theories of metallic structures admitted by the generality of chemists. The old *exact* parallels between salts of hydrogen and salts of metals is no longer maintained in its integrity. Between the formulæ for acetic acid and acetate of zinc we no longer see the ancient all-but-identity.

They used to be*—

$$\left. \begin{array}{l} C_2H_3O \\ H \end{array} \right\} O \qquad \left. \begin{array}{l} C_2H_3O \\ Zn \end{array} \right\} O$$

They are to-day—

$$\left. \begin{array}{l} C_2H_3O \\ H \end{array} \right\} O \qquad \left. \begin{array}{l} (C_2H_3O)_2 \\ Zn'' \end{array} \right\} O_2$$

And, in making proposals for sweeping changes in the notation of metallic compounds, I have not to confront a simple and uniform body of notation, but, on the contrary, the confused and, in many respects, arbitrarily-complex formulæ which are strewed through that deluge of modern text-books of chemistry which has flooded the scientific press.

A comparison of the chemical characters of hydrogen compounds with those of metallic compounds will next be instituted.

One of the chief arguments in support of analogy between hydrogen and metals may be stated as follows:—

For every acid (which is a salt of hydrogen), there exists a whole series of metallic derivatives (salts of the metals); and the properties of salts present a graduated series, in which series the properties of the hydrogen term (or acid) constitute a sort of natural first-term.

In criticism, it may be urged that, although there cannot be an acid and no corresponding salts (for the definitional reason that we require salts in order to recognise the claim to be regarded as an acid), still the converse does not hold good. We do know salts the acids corresponding to which are non-existent, or, at any rate, have hitherto resisted all attempts to prepare them. Moreover, the case of exceeding stability in the metallic salts, and exceeding fragility in the acid, is of frequent occurrence. One of the most familiar maxims in the practical management of chemical operations is that there is a world of difference between that kind of chemical action which takes place in neutral or alkaline solutions and that which happens in presence of free acid. Solution of chromic acid is an oxidising agent of great potency. Solutions of chromates of the metals are almost destitute of oxidising power. These differences between the properties of the acid and the properties of its salts lead on to the discussion of the question of the series of salts with the so-called salt of hydrogen for its initial term.

The sulphates, for example. Water typists tell us that sulphate of potash is inert, because potassium is so strongly electro-positive as to balance the strongly electro-negative sulphuryl which is bound to it by the in-

* Ten years ago, in commenting on the vapour-densities of metallic compounds, I employed the phrase—Zinc and mercury, regarded as to the densities of their compounds, are to be looked upon as representatives, not of hydrogen, but of oxygen. My own views respecting the structure of zinc compounds have, it is true, undergone development since that time, but still, the train of thought which dictated the phrase is in accordance with my present convictions on the subject.

tervention of oxygen. Sulphuric acid is energetic, because hydrogen is not sufficiently electro-positive to counterpoise the sulphuryl.

But the water typists fail to explain how it comes to pass that sulphate of silver is not energetic; for, since silver is unquestionably less electro-positive than hydrogen, the silver-salt should be even less balanced than the hydrogen-salt.

Bearing in mind that the electro-chemical place of hydrogen is, in reality, an intermediate one, hydrogen being more electro-positive than some metals, and less so than others, it is difficult to see on what principle the so-called salt of hydrogen can be made to occupy the first place in the saline series. Obviously, it would not do to range in series according to volatility. (Mercury comes next to hydrogen in volatility, and yet mercury-salts are not particularly like acids). Neither could an arrangement according to magnitude of atomic weight be attempted; for the properties of salts are obviously not related to the atomic weights of the metals.

In short, though there are gradations of properties among the metallic salts, these gradations are broken in arriving at the so-called salts of hydrogen; and, in addition to those broad and obvious distinctions between acids and salts which have arrested the attention of chemists ever since chemistry began to be cultivated, there is a fundamental dissimilarity that is at least as broad as that which lies on the surface of the subject.

Recurring to the statement of the water typists that, for every acid, there exists a whole series of metallic derivatives, I have to remark that this should be carefully distinguished from another statement, viz.:—"For every atom of hydroxyl in a compound, an equivalent of *metaloxyl* may be substituted." This latter statement is especially far removed from the truth. By far the greater part of the hydroxyl, the existence of which is recognised by chemists, is incapable of undergoing even pseudo-replacement by most kinds of metaloxyl. I need hardly refer particularly to the now well-known distinction in organic chemistry between such hydroxyl the hydrogen of which is recognised as being easily replaceable by metals, and such as does not admit of such replacement.

It will not be necessary to do more than allude to the fact that the vast array of compounds of carbon with hydrogen is unrepresented by corresponding compounds of carbon with metals. When zinc was made to unite with ethyl, there did not result a representative of ethyl-hydride, but a representative of ethyl-oxide, which is double. When sodium was made to combine with ethyl, it dragged along with it zinc in union with ethyl, and furnished a representative, not of ethyl-hydride, but of ammonia.

From the foregoing, it appears that there is the utmost fundamental dissimilarity between hydrogen and metals. On a future occasion, I propose to develop the new notation of metallic compounds.

London, Feb. 21st, 1870.

A NEW THEORY OF THE CONSTITUTION OF METALLIC COMPOUNDS.

BY J. ALFRED WANKLYN.

In most recent manuals of chemistry, whilst nitrate of potash is written KNO_3, nitrate of baryta is written $Ba''N_2O_6$; nitrate of zinc, $Zn''N_2O_6$, &c. In short, whilst the salts of the alkalies and of silver figure as if they were like salts of ethyl, the salts of barium, calcium, magnesium, mercury, zinc, &c., are made to resemble, in formula, the salts of ethylene. Such being the case, it might be expected that the characteristics of distinguishing alcohol compounds from glycol compounds should be presented by the two classes of metallic salts—for instance, the property of forming a fully-saturated and a half-saturated salt might be looked for in barium compounds. We know, however, of no half-nitrate or half-acetate of baryta; and, speaking generally, although the adoption of the two orders of formula for the two classes of metals is an assertion that monobasic acids form only one salt with an alkali-metal or with silver, and two salts with every such metal as barium, yet chemists do not know that such is the case (as a matter of experiment).

That the present glycol-formulæ for the compounds of barium, calcium, magnesium, &c., should have come into general use, and that there should be next to no experimental support for these formulæ, is a most extraordinary thing, and speaks volumes for the depressed state of our chemical conservatives.

The reasons for the adoption of glycol formulæ in the instance of certain metals were partly some very doubtful deductions drawn from the specific heat of the metals, and mainly considerations of the vapour-density of certain metallic compounds.

The facts ascertained concerning the vapour-densities of metallic substances are as follows:—

If the atomic weight of mercury be calculated from the vapour-density of metallic mercury, we arrive at the number 100 for the atomic weight of the metal. In like manner, calculating from the vapour-density of metallic zinc, we get 32·5 for the atomic weight of the metal. But, if, instead of operating upon the metal, we take the chloride or the eythl-compound, and deduce the atomic weights from the vapour-densities of those compounds, we get 200 for mercury and 65 for zinc. In presence of this discrepancy, chemists have elected to receive the values obtained from the chlorides or eythl-compounds, and to reject those from the free metals. This procedure involves rather startling theoretical consequences. Chemists maintain that oxygen, hydrogen, nitrogen, chlorine, bromine, and iodine, when existing in the free state, exist in the form of molecules, each molecule being formed of two atoms. Chemists maintain, also, that free sulphur, or free phosphorus, or free arsenic exists in the state of molecules, whereof each molecule contains more than two atoms of the element; and, along with all this, chemists maintain that metallic mercury or zinc consists of molecules, whereof each molecule contains only *one* atom of the element. If so vital a distinction existed between the constitution of a free metal and a free metalloid, we ought to find a stupendous difference in chemical or physical properties accompanying these differences in structure. There is, however, nothing very special about metallic mercury or metallic zinc—nothing that should lead to the adoption of extraordinary formulæ for them.

In the new system of notation which I propose, I take the molecule of zinc and of mercury as consisting of two atoms, just as in the case of oxygen, hydrogen, nitrogen, or chlorine; and I take the great density of the vapours of chloride of mercury and zinc-ethyl as proving that these compounds belong to the second rank of mercurial or zinc compounds. The new nota-

tion, as a consequence of this mode of treatment, does not require that potash, barium, and zinc salts should be written on radically different types, but restores to the chemistry of the metals much of the simplicity which has been so recently lost.

In two papers published in the Chemical News (vol. xx., pp. 293, 313; *Am. Repr., Feb.* 1870, pages 80, 81), I gave the new formulæ for the compounds of sodium. I now give the new formulæ for the compounds of zinc—

$$Zn''' = 32{\cdot}5$$

Free zinc.....$Zn'''.Zn'''$

Oxide of zinc.....$Zn''' \left\{ \begin{matrix} O \\ — \\ — \end{matrix} \right\} Zn'''$

Hydrated oxide of zinc .....$Zn''' \left\{ \begin{matrix} O'' \\ H \end{matrix} \right.$

Nitrate of zinc.....$Zn''' \left\{ \begin{matrix} O' \\ NO_2 \end{matrix} \right.$

Acetate of zinc.....$Zn''' \left\{ \begin{matrix} O'' \\ (C_2H_3O)' \end{matrix} \right.$

Sulphate of zinc.....$Zn'' \left\{ \begin{matrix} O'' & O'' \\ —SO_2— & \end{matrix} \right\} Zn'''$

Chloride of zinc.....$Zn''' \left\{ \begin{matrix} Cl & Cl \\ — & \\ — & \end{matrix} \right\} Zn'''$

Zinc-ethyl.....$Zn''' \left\{ \begin{matrix} C_2H_5 & C_2H_5 \\ — & \\ — & \end{matrix} \right\} Zn'''$

Hydrochlorate of zinc.....$Zn''' \left\{ \begin{matrix} OH \\ Cl \\ H \end{matrix} \right.$

The double compound of zinc-ethyl and sodium-ethyl I write—

$$Na''' \left\{ \begin{matrix} (Zn_2)''C_2H_5 \\ C_2H_5 \\ C_2H_5 \end{matrix} \right.$$

From the foregoing, and from these examples, and from those given in my two papers which appeared in the Chemical News (vol. xx., pp. 293, 313; *Am. Repr., Feb.* 1870, pages 80, 81), it will be perceived that I propose to write the compounds of the so-called "diatomic metals" in the same way as the compounds of the so-called monatomic metals, and that, in fact, I deny that any metal is diatomic. Into the same great class I put potassium, sodium, lithium, cæsium, rubidium, thallium, barium, strontium, calcium, magnesium, zinc, cadmium, mercury, manganese, bismuth, antimony, arsenic, phosphorus, nitrogen, and some others. This is the 3, 5, 7 atomic class.

Into class 2 is put tin, iron, aluminium, chromium, and some others. Class 2 is 4-atomic.

All the metals fall into one or other of these two classes.

Some of the principles embodied in the new mode of notation are:—

That the metals are fundamentally unlike hydrogen, and that they are eminently polyatomic.

That, most commonly, the metallic chlorides and ethyl-compounds are more complicated in structure than very many other compounds of the metal.

That the hydrated chloride is usually a definite compound.

That double decompositions take place by exchange of the acid-forming radicals of two salts.

On a future occasion, I propose to give examples of the new notation.

London, February 26th, 1870.

ON THE

CONTINUITY OF THE GASEOUS AND LIQUID STATES OF MATTER.*

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In 1822 M. Cagniard de la Tour observed that certain liquids, such as ether, alcohol, and water, when heated in hermetically sealed glass tubes, became apparently reduced to vapour in a space from twice to four times the original volume of the liquid. He also made a few numerical determinations of the pressures exerted in these experiments. In the following year Faraday succeeded in liquefying, by the aid of pressure alone, chlorine and several other bodies known before only in the gaseous form. A few years later Thilorier obtained solid carbonic acid, and observed that the coefficient of expansion of the liquid for heat is greater than that of any aëriform body. A second memoir by Faraday, published in 1826, greatly extended our knowledge of the effects of cold and pressure on gases. Regnault has examined with care the absolute change of volume in a few gases when exposed to a pressure of twenty atmospheres, and Pouillet has made some observations on the same subject. The experiments of Natterer have carried this inquiry to the enormous pressure of 2790 atmospheres; and although his method is not altogether free from objection, the results he obtained are valuable and deserve more attention than they have hitherto received.

In 1861 a brief notice appeared of some of my early experiments in this direction. Oxygen, hydrogen, nitrogen, carbonic acid, and nitric oxide were submitted to greater pressures than had previously been attained in glass tubes, and while under these pressures they were exposed to the cold of the carbonic acid and ether-bath. None of the gases exhibited any appearance of liquefaction, although reduced to less than 1-500th of their ordinary volume by the combined action of cold and pressure. In the third edition of Miller's "Chemical Physics," published in 1863, a short account, derived from a private letter addressed by me to Dr. Miller, appeared of some new results I had obtained, under certain fixed conditions of pressure and temperature, with carbonic acid. As these results constitute the foundation of the present investigation and have never been published in a separate form, I may, perhaps, be permitted to make the following extract from my original communication to Dr. Miller. "On partially liquefying carbonic acid by pressure alone, and gradually raising at the same time the temperature to 88° F., the surface of demarcation between the liquid and gas became fainter, lost its curvature, and at last disappeared. The space was then occupied by a homogeneous fluid, which exhibited, when the pressure was suddenly diminished or the temperature slightly lowered, a peculiar appearance of moving or flickering striæ throughout its entire mass. At temperatures above 88° no apparent liquefaction of carbonic acid, or separation into two distinct forms of matter, could be effected, even when a pressure of 300 or 400 atmospheres was applied. Nitrous oxide gave analogous results."†

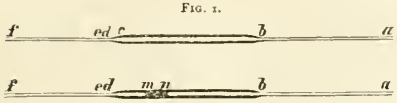
In the following experiments the gas to be compres-

* The Bakerian Lecture for 1869, delivered before the Royal Society. Communicated to the Chemical News, and revised by the author.

† Miller's "Chemical Physics," 3rd edition, p. 328.

sed is introduced into a tube, *f, a* (Fig. 1), having a capillary bore from *a* to *b*, a diameter of about 2·5 m. m. from *b* to *c*, and of 1·25 m.m. from *c* to *f*. The gas carefully dried is passed for several hours through the tube open at both ends, as represented below. The presence of a column of water of two metres in height

Fig. 1.



was necessary to maintain a moderate stream of gas through the fine capillary tube. In the case of carbonic acid, the gas, after passing through the apparatus, was made to bubble by means of a connecting tube through mercury, and a portion was collected from time to time, in order to ascertain its purity. The current was continued till the residual air, after the action of caustic potash, was reduced to a constant minimum. In repeated trials I found that in the complicated arrangements I had to adopt, the residual air could not be reduced to less than from 1-500th to 1-1000th of the entire volume of the carbonic acid. Even after continuing the current for twenty-four hours this residue appeared; and in discussing some of the results obtained by exposing the gas to high pressures, the presence of this small quantity of air must be carefully taken into account. The capillary end at *a* was then sealed, and the other end was also closed, and afterwards introduced under a surface of pure mercury contained in a glass capsule. The lower end, while under the surface of the mercury, was opened, and heat applied so as to expel a little of the gas. On cooling, contraction occurred, and a short column of mercury entered. The capsule and lower end of the tube were then placed under the receiver of an air-pump, and a partial vacuum was formed till about one-fourth of the gas was removed. On restoring the pressure, a column of mercury entered and occupied the place of the expelled gas. By withdrawing the end of the tube from below the surface of the mercury in the capsule, and again exhausting cautiously, the column of mercury should be reduced to any required length. The tube, when thus filled, had the form shown in Fig. 1.

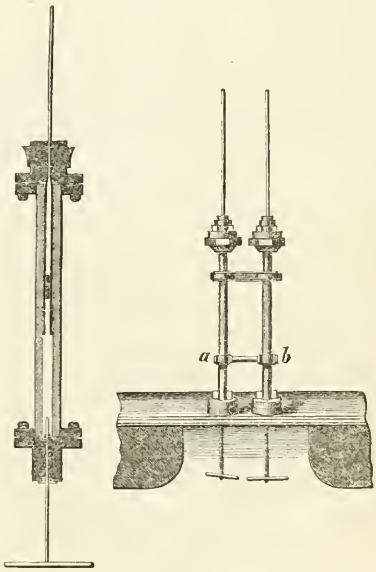
Two file-marks had been made, one at *d*, the other at *e*, in the narrow part of the tube, about 10 m.m. distant from each other, and the capacity of the tube from a mark near *a* to *d*, and also from the same mark to *e*, had been determined by filling it with mercury at a known temperature and weighing the mercury. The tube was now placed accurately in a horizontal position and connected by an air-tight junction with one limb of a long U-tube filled with mercury. Each limb of the U-tube was 600 m.m. long, and 11 m.m. in diameter. By removing mercury from the outer limb of the U-tube, a partial vacuum was obtained, and the column of mercury, *m, n*, was drawn into the narrow tube, *d, f*. From the difference of capacity of this part of the tube, the column of mercury was now about four times longer than before. It was easy with a little care so to adjust the pressure that the inner end of the mercurial column coincided with the mark *e*. When this was accomplished, the difference of level of the mercury in the two limbs of the U-tube was accurately read by means of a cathetometer, and the height of the barometer as well as the temperature were carefully noted. Similar observations were made with the gas expanded to the mark *d*. Two independent sets of data were thus obtained for calculating the volume of the gas at 0° C. and 760 m.m., and the results usually agreed to less than 1-1000 part. The tube, after being disconnected with the U-tube, was cut across a little beyond *e*, and was now ready to be introduced into the pressure apparatus.

The capillary tubes were calibrated with great care, and their mean capacity was determined by weighing a column of mercury whose length and position in the tube were accurately observed. One m.m. of the air-tube used in these experiments had an average capacity of 0·00002477 c.c., and 1 m.m. of the carbonic-acid tube of 0·00003376 c.c. A table was constructed showing the corrected capacity of each capillary tube from the sealed end for every m.m. of its length. An allowance of 0·5 m.m. was made for the cone formed in sealing the tube.

For the sake of clearness I have described these operations as if they were performed in the detached tube. In actual practice, the tube was in the brass end-piece before it was filled with gas.

The construction of the apparatus employed in these experiments will be readily understood from Fig. 2,

Fig. 2. Fig. 3.



which exhibits a section of the simple form. Two massive brass flanges are firmly attached round the ends of a cold-drawn copper tube of great strength, and by means of these flanges two brass end-pieces can be securely bolted to the ends of the copper tube, and the connections made air-tight by the insertion of leather washers. The lower end-piece carries a steel screw, 180 m.m. long, 4 m.m. in diameter, and with an interval of 0·5 m.m. between each thread. The screw

is packed with care, and readily holds a pressure of 400 atmospheres or more. A similar end-piece attached to the upper flange carries the glass tube containing the gas to be compressed. The apparatus, before being screwed up, is filled with water, and the pressure is obtained by screwing the steel screw into the water.

In the compound apparatus (Fig. 3) the internal arrangements are the same as in the simple form. A communication is established between the two sides of the apparatus through *a*, *b*. It is indifferent which of the steel screws below is turned, as the pressure is immediately diffused through the interior of both copper tubes, and is applied through the movable columns of mercury to the two gases to be compressed. Two screws are employed for the purpose of giving a greater command of pressure. In the figure the apparatus is represented without any accessories; when in use it is provided with arrangements for maintaining the capillary tubes and body of the apparatus itself at fixed temperatures. A rectangular brass case, closed before and behind with plate glass, surrounds each capillary tube, and allows it to be maintained at any required temperature by the flow of a stream of water. The body of the apparatus itself is enclosed in an external vessel of copper, which is filled with water at the temperature of the apartment. This latter arrangement is essential when accurate observations are made.*

The temperature of the water surrounding the air tube was made to coincide, as closely as possible, with that of the apartment, while the temperature of the water surrounding the carbonic acid tube varied in different experiments from 13° C. to 48° C. In the experiments to be described in this communication, the mercury did not come into view in the capillary part of the air-tube till the pressure amounted to about forty atmospheres. The volumes of the air and of the carbonic acid were carefully read by a cathetometer, and the results could be relied on with certainty to less than 0·05 m.m. The temperature of the water around the carbonic-acid tube was ascertained by a thermometer carefully graduated by myself according to an arbitrary scale. This thermometer was one of a set of four, which I constructed some years ago, and which all agreed so closely in their indications, that the differences were found to be altogether insignificant when their readings were reduced to degrees.

The general form of the curves representing the changes of volume in carbonic acid will hardly undergo any sensible change from the irregularities in the air-tube; nor will any of the general conclusions at which I have arrived be affected by them. It must, however, always be understood that when the pressures are occasionally spoken of as indicated by the apparent contraction of the air in the air-gauge, the approximate pressures only are meant.

To obtain the capacity in cubic centimetres from the weight in grammes of the mercury which filled any part of a glass tube, the following formula was used,

$$C = W.\frac{1 + 0\cdot000154.t}{13\cdot596}.1\cdot00012,$$

where C is the capacity in c.c., W the weight of the mercury which filled the tube at the temperature t, 0·000154 the coefficient of apparent expansion of mercury in glass, 13·596 the density of mercury at 0°, and 1·00012 the density of water at 4°.

* In the original memoir a figure is given representing the apparatus with all these accessories.

The volume of the gas V, at 0° and 760 m.m. of pressure, was deduced from the double observations, as follows.

$$V = C.\frac{1}{1 + a\,t}.\frac{h - d}{760}$$

where C is the capacity of the tube (Fig. 1) from *a* to *d*, or from *a* to *e*, t the temperature, a the coefficient of expansion of the gas for heat (0·00366 in the case of air, 0·0037 in that of carbonic acid), h the height of the barometer reduced to 0° and to the latitude of 45°, d the difference of the mercurial columns in the U-tube, similarly reduced.

Having thus ascertained the volumes of the air and of the carbonic acid before compression, at 0° and 760 m.m., it was easy to calculate their volumes under the same pressure of 760 m.m., at the temperatures at which the measurements were made when the gases were compressed, and thence to deduce the values of the fractions representing the diminution of volume. But the fractions thus obtained would not give results directly comparable for air and carbonic acid. Although the capillary glass tubes in the apparatus communicated with the same reservoir, the pressure on the contained gases was not quite equal, in consequence of the mercurial columns, which confined the air and carbonic acid, being of different heights. The column always stood higher in the carbonic-acid tube than in the air tube, so that the pressure in the latter was a little greater than in the former. The difference in the lengths of the mercurial columns rarely exceeded 200 m.m., or about one-fourth of an atmosphere. This correction was always applied, as was also a trifling correction of 7 m.m. for a difference of capillary depression in the two tubes.

In order to show more clearly the methods of reduction, I will give the details of one experiment.

Volume of air at 0° and 760 m.m. calculated from the observations when the air was expanded to *a c*, 0·3124 c.c.

Volume of same air calculated from the observations when the air was expanded to *a d*, 0·3122 c.c.

Mean volume of air at 0° and 760 m.m., 0·3123 c.c.

The volumes of the carbonic acid, deduced in like manner from two independent observations, were 0·3096 c.c. and 0·3094 c.c. Mean, 0·3095 c.c.

The length of the column of air, after compression at 10·76° in the capillary air-tube, was 272·9 m.m., corresponding to 0·006757 c.c. Hence we have—

$$\delta' = \frac{0\cdot006757}{0\cdot3123 \times 1\cdot0394} = \frac{1}{48\cdot04}$$

But, as the difference in the heights of the mercurial columns in the air-tube and carbonic acid tube after allowing for the difference of capillary depression was 178 m.m., this result requires a further correction—$\frac{178}{760}$ of an atmosphere—in order to render it comparable with the compression in the carbonic acid tube. The final value for δ (the fraction representing the ratio of the volume of the compressed air at the temperature of the experiment to its volume at the same temperature and under the pressure of one atmosphere) will be—

$$\delta = \frac{1}{47\cdot81}$$

The corresponding length of the carbonic acid at 13·22°, in its capillary tube, was 124·6 m.m., equiva-

lent to 0·004211 c.c. from which we deduce for the corresponding fraction for the carbonic acid—

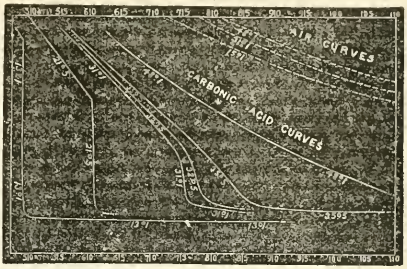
$$\epsilon = \frac{0{\cdot}004211}{0{\cdot}3095 \times 1{\cdot}0489} = \frac{1}{77{\cdot}09}$$

Hence, it follows that the same pressure which reduced a given volume of air at 10·76° to $\frac{1}{47{\cdot}81}$ of its volume, at the same temperature, under one atmosphere, reduced carbonic acid at 13·22° to $\frac{1}{77{\cdot}09}$ of its volume, at the temperature of 13·22°, and under a pressure of one atmosphere. Or, assuming the compression of the air to be approximately a measure of the pressure, we may state that, under a pressure of about 47·8 atmospheres, carbonic acid, at 13·22°, contracts to $\frac{1}{77{\cdot}09}$ of its volume under one atmosphere.

At the pressure of 48·89 atmospheres, as measured by the contraction of the air in the air-tube, liquefaction began. This point could not be fixed by direct observation, inasmuch as the smallest visible quantity of liquid represented a column of gas at least 2 or 3 m.m. in length. It was, however, determined indirectly by observing the volume of the gas 0·2° or 0·3° above the point of liquefaction, and calculating the contraction the gas would sustain in cooling down to the temperature at which liquefaction began. A slight increase of pressure was required even in the early stages to carry on the process. Thus the air-guage, after all reductions were made, indicated an increase of pressure of about one-fourth of an atmosphere (from 48·49 to 49·15 atmospheres) during the condensation of the first and second thirds of the carbonic acid. According to theory, no change of volume ought to have occurred. This apparent anomaly is explained by the presence of the trace of air (about 1-500th part) in the carbonic acid to which I before referred. It is easy to see that the increase of pressure shown in these experiments is explained by the presence of this small quantity of air. If a given volume of carbonic acid contain 1-500th of air, that air will be diffused through a space 500 times greater than if the same quantity of air were in a separate state. Compress the mixture till 50 atmospheres of pressure have been applied, and the air will now occupy, or be diffused through, ten times the space it would occupy if alone and under the pressure of one atmosphere; or it will be diffused through the space it would occupy if alone and under the pressure of 1-10th of an atmosphere. While the carbonic acid is liquefying, pressure must be applied in order to condense this air; and to reduce it to one-half its volume, an increase of 1-10th of an atmosphere is required. The actual results obtained by experiment approximate to this calculation. From similar considerations, it follows that if a mixture of air and carbonic acid be taken, for example in equal volumes, the pressure, after liquefaction has begun, must be augmented by several atmospheres, in order to liquefy the whole of the carbonic acid. Direct experiments have shown this conclusion to be true.

The small quantity of air in the carbonic acid disturbed the liquefaction in a marked manner, when nearly the whole of the carbonic acid was liquefied, and when its volume relatively to that of the uncondensed carbonic acid was considerable. It resisted for some time absorption by the liquid, but on raising the pressure to 50·4 atmospheres it was entirely absorbed. If the carbonic acid had been absolutely pure, the part of the curve for 13·1° representing the fall from the gaseous to the liquid state, would doubtless have been straight throughout its entire course, and parallel to the lines of equal pressure.

Fig. 4.



The curve representing the results at 21·5° agrees in general form with that for 13·1°, as shown in the above figure. At 13·1°, under a pressure of about 49 atmospheres, the volume of carbonic acid is little more than three-fifths of that which a perfect gas would occupy under the same conditions. After liquefaction, carbonic acid yields to pressure much more than ordinary liquids; and the compressibility appears to diminish as the pressure increases. The high rate of expansion by heat of liquid carbonic acid, first noticed by Thilorier, is fully confirmed by this investigation.

The next series of experiments was made at the temperature of 31·1°, or 0·2° above the point at which, by compression alone, carbonic acid is capable of assuming visibly the liquid form. Since I first announced this fact in 1863, I have made careful experiments to fix precisely the temperature of this critical point in the case of carbonic acid. It was found in three trials to be 30·92° C., or 87·7° F. Although for a few degrees above this temperature a rapid fall takes place from increase of pressure, when the gas is reduced to the volume at which it might be expected to liquefy, no separation of the carbonic acid into two distinct conditions of matter occurs, so far as any indication of such a separation is afforded by the action of light. By varying the pressure or temperature, but always keeping above 30·92°, the great changes of density which occur about this point produce the flickering movements I formerly described, resembling in an exaggerated form the appearances exhibited during the mixture of liquids of different densities, or when columns of heated air ascend through colder strata. It is easy so to adjust the pressure that one-half of the tube shall be filled with uncondensed gas and one-half with the condensed liquid. Below the critical temperature this distinction is easily seen to have taken place, from the visible surface of demarcation between the liquid and gas, and from the shifting at the same surface of the image of any perpendicular line placed behind the tube. But above 30·92° no such appearances are seen, and the most careful examination fails to discover any heterogeneity in the carbonic acid, as it exists in the tube.

The graphical representation of these experiments, as shown in Fig. 4, exhibits some marked differences from the curves for lower temperatures. The dotted lines in the figure represent a portion of the curves of a perfect gas (assumed to have the same volume at 0° and under one atmosphere as the carbonic acid) for the tem-

[English Edition, Vol. XXI., No. 536, page 103; No. 537, pages 111, 112.]

peratures of 13·1°, 31·1°, and 48·1°. The volume of the carbonic acid at 31·1°, it will be observed, diminishes with tolerable regularity, but much faster than according to the law of Mariotte, till a pressure of about 73 atmospheres is attained. The diminution of volume then goes on very rapidly, a reduction to nearly one-half taking place, when the pressure is increased from 73 to 75 atmospheres, or only by 1-37th of the whole pressure. The fall is not, however, abrupt as in the case of the formation of the liquid at lower temperatures, but a steady increase of pressure is required to carry it through. During this fall, as has already been stated, there is no indication at any stage of the process of two conditions of matter being present in the tube. Beyond 77 atmospheres carbonic acid at 31·1° yielded much less than before to pressure, its volume having become reduced nearly to that which it ought to occupy as a liquid at the temperature at which the observations were made.

The curve for 32·5° (Fig. 4) resembles closely that for 31·1°. The fall is, however, less abrupt than at the latter temperature. The range of pressure in the experiments at 35·5° extends from 57 to above 107 atmospheres. The fall is here greatly diminished, and it has nearly lost its abrupt character. It is most considerable from 76 to 87 atmospheres, where an increase of one-seventh in the pressure produces a reduction of volume to one-half. At 107 atmospheres the volume of the carbonic acid has come almost in conformity with that which it should occupy, if it were derived directly from liquid carbonic acid, according to the law of the expansion of that body for heat.

The curve for 48·1° is very interesting. The fall shown in the curves for lower temperatures has almost, if not altogether, disappeared, and the curve itself approximates to that which would represent the change of volume in a perfect gas. At the same time the contraction is much greater than it would have been if the law of Mariotte had held good at this temperature. Under a pressure of 109 atmospheres, the carbonic acid is rapidly approaching to the volume it would occupy if derived from the expansion of the liquid; and if the experiment had not been interrupted by the bursting of one of the tubes, it would doubtless have fallen into position at a pressure of 120 or 130 atmospheres.

I have not made any measurements at higher temperatures than 48·1°; but it is clear that, as the temperature rises, the curve would continue to approach to that representing the change of volume of a perfect gas.

I have frequently exposed carbonic acid, without making precise measurements, to much higher pressures and have made it pass, without break or interruption, from what is regarded by every one as the gaseous state, to what is, in like manner, universally regarded as the liquid state. Take, for example, a given volume of carbonic acid gas at 50° C., or at a higher temperature, and expose it to increasing pressure till 150 atmospheres have been reached. In this process its volume will steadily diminish as the pressure augments, and no sudden diminution of volume, without the application of external pressure, will occur at any stage of it. When the full pressure has been applied, let the temperature be allowed to fall till the carbonic acid has reached the ordinary temperature of the atmosphere. During the whole of this operation no breach of continuity has occurred. It begins with a gas, and by a series of gradual changes, presenting nowhere any abrupt alteration of volume or sudden evolution of heat, it ends with a liquid. The closest observation fails to discover anywhere indications of a change of condition in the carbonic acid, or evidence, at any period of the process, of part of it being in one physical state and part in another. That the gas has actually changed into a liquid would, indeed, never have been suspected, had it not shown itself to be so changed by entering into ebullition on the removal of the pressure. For convenience, this process has been divided into two stages, the compression of the carbonic acid and its subsequent cooling; but these operations might have been performed simultaneously, if care were taken so to arrange the application of the pressure and the rate of cooling, that the pressure should not be less than 76 atmospheres when the carbonic acid had cooled to 31°.

We are now prepared for the consideration of the following important question. What is the condition of carbonic acid when it passes, at temperatures above 31°, from the gaseous state down to the volume of the liquid, without giving evidence at any part of the process of liquefaction having occurred? Does it continue in the gaseous state, or does it liquefy, or have we to deal with a new condition of matter? If the experiment were made at 100°, or at a higher temperature, when all indications of a fall had disappeared, the probable answer which would be given to this question is that the gas preserves its gaseous condition during the compression; and few would hesitate to declare this statement to be true, if the pressure, as in Natterer's experiments, were applied to such gases as hydrogen or nitrogen. On the other hand, when the experiment is made with carbonic acid at temperatures a little above 31°, the great fall which occurs at one period of the process would lead to the conjecture that liquefaction had actually taken place, although optical tests carefully applied failed at any time to discover the presence of a liquid in contact with a gas. But against this view it may be urged with great force, that the fact of additional pressure being always required for a further diminution of volume, is opposed to the known laws which hold in the change of bodies from the gaseous to the liquid state. Besides, the higher the temperature to which the gas is compressed, the less the fall becomes, and at last it disappears.

The answer to the foregoing question, according to what appears to me to be the true interpretation of the experiments already described, is to be found in the close and intimate relations which subsist between the gaseous and liquid states of matter. The ordinary gaseous and ordinary liquid states are, in short, only widely separated forms of the same condition of matter, and may be made to pass into one another by a series of gradations so gentle that the passage shall nowhere present any interruption or breach of continuity. From carbonic acid as a perfect gas to carbonic acid as a perfect liquid, the transition we have seen may be accomplished by a continuous process, and the gas and liquid are only distant stages of a long series of continuous physical changes. Under certain conditions of temperature and pressure, carbonic acid finds itself, it is true, in what may be described as a state of instability, and suddenly passes, with the evolution of heat, and without the application of additional pressure or change of temperature, to the volume, which by the continuous process can only be reached through a long and circuitous route. In the abrupt change which here occurs, a marked difference is exhibited, while the process is going on, in the optical and other physical properties of the carbonic acid which has collapsed into the smaller

volume, and of the carbonic acid not yet altered. There is no difficulty here, therefore, in distinguishing between the liquid and the gas. But in other cases the distinction cannot be made; and under many of the conditions I have described it would be vain to attempt to assign carbonic acid to the liquid rather than the gaseous state. Carbonic acid, at the temperature of 35·5°, and under a pressure of 108 atmospheres, is reduced to 1-430th of the volume it occupied under a pressure of one atmosphere; but if any one ask whether it is now in the gaseous or liquid state, the question does not, I believe, admit of a positive reply. Carbonic acid at 35·5°, and under 108 atmospheres of pressure, stands nearly midway between the gas and the liquid; and we have no valid grounds for assigning it to the one form of matter any more than to the other. The same observation would apply with even greater force to the state in which carbonic acid exists at higher temperatures and under greater pressures than those just mentioned. In the original experiment of Cagniard de la Tour, that distinguished physicist inferred that the liquid had disappeared, and had changed into a gas. A slight modification of the conditions of his experiment would have led him to the opposite conclusion, that what had been before a gas was changed into a liquid. These conditions are, in short, the intermediate states which matter assumes in passing, without sudden change of volume, or abrupt evolution of heat, from the ordinary liquid to the ordinary gaseous state.[1]

In the foregoing observations I have avoided all reference to the molecular forces brought into play in these experiments. The resistance of liquids and gases to external pressure tending to produce a diminution of volume, proves the existence of an internal force of an expansive or resisting character. On the other hand, the sudden diminution of volume, without the application of additional pressure externally, which occurs when a gas is compressed, at any temperature below the critical point, to the volume at which liquefaction begins, can scarcely be explained without assuming that a molecular force of great attractive power comes here into operation, and overcomes the resistance to diminution of volume, which commonly requires the application of external force. When the passage from the gaseous to the liquid state is effected by the continuous process described in the foregoing pages, these molecular forces are so modified as to be unable at any stage of the process to overcome alone the resistance of the fluid to change of volume.

The properties described in this communication, as exhibited by carbonic acid, are not peculiar to it, but are generally true of all bodies which can be obtained as gases and liquids. Nitrous oxide, hydrochloric acid, ammonia, sulphuric ether, and sulphuret of carbon, all exhibited, at fixed pressures and temperatures, critical points, and rapid changes of volume with flickering movements, when the temperature or pressure was changed in the neighbourhood of those points. The critical points of some of these bodies were above 100°; and in order to make the observations, it was necessary to bend the capillary tube before the commencement of the experiment, and to heat it in a bath of paraffin or oil of vitriol.

The distinction between a gas and vapour has hitherto been founded on principles which are altogether arbitrary. Ether in the state of gas is called a vapour, while sulphurous acid in the same state is called a gas; yet they are both vapours, the one derived from a liquid boiling at 35°, the other from a liquid boiling at −10°. The distinction is thus determined by the trivial condition of the boiling point of the liquid, under the ordinary pressure of the atmosphere, being higher or lower than the ordinary temperature of the atmosphere. Such a distinction may have some advantages for practical reference, but it has no scientific value. The critical point of temperature affords a criterion for distinguishing a vapour from a gas, if it be considered important to maintain the distinction at all. Many of the properties of vapours depend on the gas and liquid being present in contact with one another; and this, we have seen, can only occur at temperatures below the critical point. We may accordingly define a vapour to be a gas at any temperature under its critical point. According to this definition, a vapour may, by pressure alone, be changed into a liquid, and may therefore exist in presence of its own liquid; while a gas cannot be liquefied by pressure, that is, so changed by pressure as to become a visible liquid distinguished by a surface of demarcation from the gas. If this definition be accepted, carbonic acid will be a vapour below 31°, a gas above that temperature; ether, a vapour below 200°, a gas above that temperature.

We have seen that the gaseous and liquid states are only distant stages of the same condition of matter, and are capable of passing into one another by a process of continuous change. A problem of far greater difficulty yet remains to be solved, the possible continuity of the liquid and solid states of matter. The fine discovery made some years ago by James Thomson, of the influence of pressure on the temperature at which liquefaction occurs, and verified experimentally by Sir W. Thomson, points, as it appears to me, to the direction this inquiry must take; and in the case at least of those bodies which expand in liquefying, and whose melting points are raised by pressure, the transition may possibly be effected. But this must be a subject for future investigation; and for the present I will not venture to go beyond the conclusion I have already drawn from direct experiment, that the gaseous and liquid forms of matter may be transformed into one another by a series of continuous and unbroken changes.

NOTE ON THE ACTION OF IODINE ON HYPOSULPHITE.*

BY C. R. A. WRIGHT, B.SC., F.C.S.

In a paper on the valuation of manganese ores, read before the Newcastle Chemical Society, on November 25th, 1869, Messrs. Sherer and Rumpf state that they find it necessary to titrate the iodine solution obtained by Bunsen's process with standard hyposulphite solution "as soon as possible after the decomposition, since the solution, in presence of air, gradually reacts on the iodide of potassium and liberates iodine;" the iodine solutions in each of two experiments requiring an amount of hyposulphite corresponding to 62·7 per cent of available peroxide in the manganese ore assayed when tested immediately after the decomposition, and to over 65 per cent after standing twenty-four hours; Fresenius and Will's process giving, with the same sample, the intermediate number, 63·5 per cent.

In order to see how far this discrepancy might be accounted for by a possible irregularity in the action of

* Read before the Newcastle-upon-Tyne Chemical Society, February 24th, 1870.

iodine on hyposulphite under different circumstances, as to temperature, &c., a solution of iodine in potassium iodide was prepared of the strength of 5 grms. free iodine to the litre; a solution of pure re-crystallised sodium hyposulphite was also prepared.

Into each of eleven flasks 25·65 c.c. of this hyposulphite was measured by a pipette delivering that amount; about 200 c.c. of water was added to each. In the first flask the quantity of iodine solution requisite to produce a blue tint along with starch, at the ordinary temperature of the air (16° C.) was determined; the second flask was heated to about 60° C., then allowed to cool, and finally titrated as before: almost the same amount of iodine being required, it appears that simply heating the hyposulphite solution does not appreciably alter the quantity of hyposulphite present.

The next eight flasks were heated to varying temperatures, and, while hot, a quantity of iodine solution, rather less than that required for the hyposulphite, as deduced from the first experiments, was added, care being taken to run the iodine direct into the warm liquid, and not down the sides of the flask, which might cause a loss of iodine by volatilisation; no smell of iodine was observed in any case. The addition of this iodine solution slightly cooling the liquids, their temperatures were again read off, the mean of the two temperatures being taken as the average; the warm liquids were then rapidly cooled by immersion of the flasks in cold water, and finally the slight excess of hyposulphite determined by iodine solution; the cooling was essential, since heat destroys the colour of the iodised starch.

The last flask was again titrated at the temperature of the air (16° C.) at the close of the experiments, to make sure that the hyposulphite had not altered spontaneously.

The numbers obtained were—

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
Temperature of solution before addition of iodine solution.....	—	—	32	40	52	55	86	88	100	100	—
Do. after.....	—	—	28	36	44	46	65	78	83	85	—
Mean temperature.....	16 C.	25	30	38	48	50	75	83	91	92	16.
C.c. of iodine required.....	39·6	39·4	39·8	40·0	40·1	40·1	40·7	40·9	41·4	41·2	39·5
Iodine required in excess of that normally requisite, viz., 39·5 c.c.....	—	—	0·3	0·5	0·6	0·6	1·2	1·4	1·9	1·7	—
Do. in per cents of the normal quantity.....	—	—	0·75	1·25	1·5	1·5	3·0	3·5	4·75	4·25	—

From these numbers it is evident that the higher the temperature the larger is the quantity of iodine requisite before a blue colour with starch is developed, *i.e.*, the action of iodine on hyposulphite is slightly irregular at varying temperatures. Since the first action of iodine is to form tetrathionate (which, as is well known, is converted into sulphate by the action of chlorine), it appears probable that the conversion of tetrathionate into sulphate by iodine may account for the excess required. Probably, therefore, if the mode of experimenting were reversed (*i.e.*, hyposulphite added to warm iodine solution, the latter being always in excess till just the close of the experiment), a greater discrepancy would be manifest. It is difficult, however, to manipulate thus without loss of iodine by volatilisation; but it was found that an excess of iodine added to hyposulphite gradually diminished on standing some hours at the ordinary temperature, *i.e.*, less residual free iodine was found after standing than was present immediately after the addition to the hyposulphite.

Thus, 25·65 c.c. of a rather weaker hyposulphite solution than that previously used was pipetted off into each of ten well stoppered bottles; two were immediately titrated with the former iodine solution, the requisite amount of iodine as thus deduced was added to each of the others; to five of them a varying excess of iodine, and to the remaining three a varying excess of hyposulphite; thus, each of the eight originally contained the same amount of tetrathionate. After standing 24 hours in a cupboard (in the dark) at the ordinary temperature (10° —20° C.), hyposulphite was added in slight excess to the five in which the iodine was originally in excess, and finally, all were titrated with the iodine solution. The following numbers were obtained:—

	Original excess of Hyposulphite.	Original excess of Iodine.	Total Hyposulphite used.	Iodine equivalent to Hyposulphite (deduced from A. and B).	Total Iodine used.	Ratio of Iodine and Hyposulphite used.
A.*	—	—	25·65	—	63·3	2·467
B.*	—	—	25·63	—	63·35	2·470
C.	—	0·1	26·25	64·8	64·9	2·472
D.	—	0·2	26·4	65·2	65·1	2·466
E.	—	6·7	28·2	69·6	72·7	2·578
F.	—	16·7	31·85	78·6	82·0	2·574
G.	—	36·7	37.85	93.6	101·9	2·692
H.	1·5	—	27·45	67·8	67·9	2·474
I.	5·9	—	31·50	77·8	77·65	2·465
J.	9·7	—	35·25	87·05	87·2	2·474

* Titrated at once.

From these numbers it appears that in the three last experiments there was no action whatever between the tetrathionate present and the excess of hyposulphite; while in experiments E, F, and G, a considerable amount of iodine has *disappeared*, this amount increasing with the original excess of iodine, thus—

	E.	F.	G.
Excess of iodine.....	6·7	16·7	36·7
Iodine disappeared.....	3·1	3·4	8·3
Ditto, in per cents of the normal amount.....	4·4	3·4	8·9

Similarly, in another experiment with the above iodine solution diluted to one-third its former strength, after 24 hours—

Original excess of iodine.....	5 c.c.	13 c.c.
Iodine corresponding to total hyposulphite used.....	163·1	164·4
Total iodine used.....	166·7	169·9
Excess of iodine.....	3·6	5·5
Ditto, in per cents of normal quantity.....	2·1	3·3

On the whole, therefore, these experiments indicate that when the temperature is not lower than 28° C., or when a mixed solution of hyposulphite and iodine still in excess is allowed to stand some time before finishing the titration, a deficiency in the amount of iodine may be expected, varying in amount with the circumstances: possibly, these facts may account for the results obtained by Messrs. Scherer and Rumpf.

The fact that sulphate is formed by the prolonged action of iodine on tetrathionate is indicated by the following experiments:—50 c.c. of the hyposulphite

solution used in the past experiments were mixed with 150 of iodine (large excess); after standing 48 hours at the ordinary temperature in the dark, hyposulphite was added till all free iodine disappeared: chloride of barium gave with this liquid a dense cloud, which, after standing, was collected, and found by the blowpipe to be really barium sulphate. 50 c.c. of the original hyposulphate with barium chloride gave not the slightest precipitate; after addition of a few drops of hydrochloric acid the solution did not become opalescent for a minute or more; and the precipitated sulphur after standing some hours was wholly volatile, showing that no sulphate whatever was present originally in the hyposulphite.

My best thanks are due to Mr. I. L. Bell, in whose laboratory the above experiments were carried out.

CONCERNING

ATOM-FIXING AND ATOM-DISPLACING POWERS.

BY WALTER NOEL HARTLEY, F.C.S.

Part I.

In Hofmann's "Modern Chemistry" occur these words: "The atomic relations which we call quantivalence imply not only atom-fixing, but also atom-displacing power; so that, in learning how many standard units of quantivalence any given elementary atom may attract and retain within a compound molecule, we learn, also, how many it can remove therefrom." According to notions now received, and facts recorded, this, with a certain class of compounds, would appear not to be the case. In Hofmann's work, nitrogen and its congeners are treated as merely trivalent; but they are now well known to have pentad functions.

Many compounds have been obtained by Griess,* in which N substitutes H_3, for instance—

$C_6H_2(NO_2)_2N_2O$,	Azopicramic acid.
$C_{12}H_{11}N_3$,	Azodianiline.
$C_{12}H_8N_4$,	Diazodianiline.

I can find, however, no instance of its displacing five standard atoms; on the other hand, in ammonium-chloride it fixes five. Here, then, is an example, showing that atom-fixing is not identical with atom-displacing power. Again, P, which is trivalent to H, is both a triad and a pentad to Cl—*e. g.*, $PCl_3.PCl_5$. From consideration of these and similar facts, I believe that, in certain elements, the full atom-fixing or displacing power is not exercised, but is partially suppressed or lies latent. For instance, Strecker obtained azobenzoic acid, in which N displaces only one atom of hydrogen, $C_{14}H_{10}N_2O_4$; by treating this with ferrous hydrate, the N takes up H; by boiling with hydrochloric acid, one other atom, H; and subsequently it fixes HCl, thus:—

$$\underbrace{C_{14}H_{10}N_2O_4}_{\text{Azobenzoic acid.}}.\quad \underbrace{C_{14}H_{12}N_2O_4}_{\text{Hydrazobenzoic acid.}}.\quad \underbrace{C_7H_7NO_2}_{\text{Amidobenzoic acid.}}.\quad \underbrace{C_7H_7NO_2-HCl}_{\text{Amidobenzoic hydrochloride.}}.$$

In the first instance, four atom-fixing powers lie latent, and they are gradually revealed until a saturated compound results.

Elements of the nitrogen class † have a much greater power of fixing three atoms than five, their most stable compounds being triadic; in fact, these compounds act as bivalent radicles, and fix two other atoms, thus:—

$$NH_3HCl,\quad PCl_3.Cl_2,\quad SbCl_3.Cl_2,$$

just as certain oxygen compounds do—*e. g.*,

$$NO''Cl_2,\quad PO''Cl_2.$$

This is an instance of what is invariably the case—viz., that the saturating power, or quantivalence, of a compound radicle is dependent on the quantivalence of the elements entering into its composition. Seeing that, in Griess's compounds, N displaces three, instead of five atoms, and, on the other hand, in NH_4HCl it fixes five, we may infer that the two weaker atom-fixing powers are incapable of displacing atoms, although they have the power of fixing them on to a molecule. The amides bear this out: NH_2 can fix three atoms; it displaces only one, however, and then fixes other two, thus—

$$\underbrace{C_7H_5(H_2N)O_2.}_{\text{Amidobenzoic acid.}}\qquad \underbrace{C_7H_5(H_2N)O_2.HCl.}_{\text{Amidobenzoic hydrochloride.}}$$

$$\underbrace{C_3H_5(H_2N)O_2.}_{\text{Alanine.}}\qquad \underbrace{C_3H_5(H_2N)O_2.HCl.}_{\text{Alanine hydrochloride.}}$$

Amidogen never displaces three atoms of hydrogen from a compound, because atom-fixing is not identical with atom-displacing power.

The compound HCN has the H combined with the C. Nitrogen being a pentad, the carbon is insufficient to saturate it; we have, therefore, two free atom-fixing powers of the nitrogen in this body. Naquet mentions this in his "Cours de Chimie." The cyanides then have the following constitution:—

$$\text{Cyanides,}\quad C^{IV}\left\{\begin{matrix}N^{V}\\M\end{matrix}\right.$$

$$\text{Isocyanides,}\quad N^{V}\left\{\begin{matrix}C^{IV}\\M\end{matrix}\right.$$

M = a metallic body.

Cyanogen is, then, a trivalent radicle; the crystalline compounds of Gauthier and Gal, of prussic acid with the haloid acids, abolish the need of any further proof of this.

$$HCN.HCl,\ HCN.HBr,\ HCN.HI,\ \text{or}\quad C^{IV}\left\{\begin{matrix}N^{V}.HCl.\\H\end{matrix}\right.$$

Hydrocyanic acid is a tertiary monamine, in which the radicle CH''' replaces three hydrogen atoms—

$$CH'''\}N.HCl.$$

The double cyanides of silver and potassium, also chlorocyanide of silver and potassium, may be thus represented:—

$$\begin{matrix}CN-Ag\\ \|\\ K-CN\end{matrix}\qquad\text{or}\qquad CN'''\left\{\begin{matrix}Ag\\K\\Cl\end{matrix}\right.$$

A trivalent radicle, when doubled to form one molecule, may become either tetrad or dyad; when trebled, either monad, triad, or pentad, in its functions, according to its inner constitution, thus:—

$$2(X''')=(\text{molecule})^{\text{IV or II.}}$$

$$3(X''')=(\text{molecule})^{\text{I, III, or V.}}$$

From this it is easy to see how the immense variety of complicated cyanides arise; to take the mercury compounds first, we have—

* *Ann. Chem. und Pharm.*, vol. cxiii., p. 201.
† Odling, in Watts's "Dictionary."

$(Hg''Cy_2)''.KBr.$ $C_2H_3Cy.CyCl.$
$(Hg''Cy_2)''.NaBr.$ $C_2H_2Cy.CO\ Cl_2.$
$(Hg''Cy_2)''.NH_4Cl.$
$(Hg''Cy_2)''.KCl.$
$(Hg''Cy_2)''.NaCl.$
$(Hg''Cy_2)''.KI.$
$(Hg''Cy_2)''.Ag.NO_3.$

Of all unstable substances, cyanide of ammonium is most strangely so; it gives off ammonia and hydrocyanic acid at ordinary temperatures, and simultaneously. The reason of this is apparent when we consider that the weaker atom-fixing powers of the nitrogen in the ammonium are united to the weaker ones of the same element in the hydrocyanic acid, thus:—

$$\left.\begin{matrix}H\\H\\H\end{matrix}\right\}\overset{v}{N}.NCH, \quad \text{or} \quad \begin{matrix}\overset{v}{N} \equiv \overset{II}{C}\ H\\ \| \\ H_3 \equiv N\end{matrix}$$

Amidogen, H_2N, is an analogue of cyanogen—that is to say, it replaces an atom of hydrogen or chlorine in various compounds.

It is evident that it resembles it closely, in being trivalent as well as univalent, in the same manner as cyanogen, by virtue of the two weaker atom-fixing powers of its nitrogen. The ammonium haloid salts resemble the compounds of Gauthier and Gal, thus:—

$$(Cy'''H_2)''HCl.$$
$$(Am'''H)''.HCl.$$

It is only necessary to recall the fact that amidogen displaces H from a molecule, and then fixes HCl in order to prove its trivalency.

Chlorine and its congeners form an exceedingly well-defined group of radicles; any compound into which one of these enters is sure to have its analogue, in which the others take part. In addition, however, to the halogens, the mono-metallic bodies come under the same quantivalential class; they form analogous compounds, have the same atomic heat,* and the same capability of displacing each other.

These elements, resembling each other to such an extent in their general powers of forming and entering into compounds, are—

H.	Tl.
K.	Au.
Na.	F. (?)
Ag.	Cl.
Cæ. (?)	Br.
R. (?)	I.

Of this list, thallium and gold are always admitted to be triads; iodine was shown by Schutzenberger † to be a triad; and Wanklyn has shown the possibility of sodium possessing triad functions. The compounds relating to this question are the following:—

$$\underbrace{I\left\{\begin{matrix}Cl\\Cl\\Cl\end{matrix}\right.}_{\text{Iodine trichloride.}} \quad \underbrace{\left.\begin{matrix}C_2H_2\\C_2H_2\\C_2H_2\end{matrix}\right\}I\left\{\begin{matrix}HO_2\\HO_2\\HO_2\end{matrix}\right.}_{\text{Iodotriacetic acid.}} \quad \underbrace{Na\left\{\begin{matrix}C_2H_3O\\C_2H_3O\\C_2H_3O\end{matrix}\right.}_{\text{Sodium triacetyl.}}$$

$$\text{Thallic chloride, } Tl\left\{\begin{matrix}Cl\\Cl\\Cl\end{matrix}\right.$$

$$\text{Gold chloride, } Au\left\{\begin{matrix}Cl\\Cl\\Cl\end{matrix}\right.$$

Of the above twelve elements, three are comparatively little known—Cæ, R, and F; of the remaining nine, four are shown to be triads, but their monad characters are the much more marked, just as in the nitrogen group. The trivalent are more predominant than the pentad functions; the reason of this I consider to be the same in each case; two of the atom-fixing powers in each class of radicles are weaker than the others. As nitrogen and its congeners have a greater power of combining with three than five atoms, so these elements have a greater power of combining with one than three. It is not at all satisfactory, when contemplating such compounds as sodium-triacetyl, iodo-triacetic acid, and iodic chloride, to be unable to account for these under the orthodox views; it rids us of the difficulty; but it is still less satisfactory to ignore their existence altogether.

A monad atom can form only one combination with any other monad; this is represented by XA; it is a union of atom with atom. It is impossible for this combination to unite with anything else, both elements being saturated.

Let us consider now what combinations of iodine—for instance, with univalent radicles, and apparently saturated compounds, exist.

$$\underset{(a)}{KI.Tl_3} \qquad \underset{(b)}{N\left\{\begin{matrix}(CH_3)_4\\I_3\end{matrix}\right.} \qquad \underset{(c)}{N\left\{\begin{matrix}(CH_3)_4\\I\end{matrix}\right.} \qquad \underset{(d)}{N\left\{\begin{matrix}(CH_3)_4\\I_{10}\end{matrix}\right.}$$

How is it possible to account for these?

Recognise I as trivalent, and the problem is without difficulty.

$$2 \text{ atoms } I = \overset{\text{II or IV}}{(I_2)}$$
$$3 \text{ atoms } I = \overset{\text{I, III, or V}}{(I_3)}$$

In (*a*), the iodine of the potassium unites with that of the thallium, and together they form a di or tetra molecule, to saturate K and Tl. With (*b*) and (*c*), the molecules* (I_3''') and (I_3''') are both univalent, and therefore fill up the unsaturated combinations—

$$N\left\{(CH_3)_4\right.$$

The substance (*d*) is more unstable than the others, which is natural from its being, perhaps, an unsaturated molecule—

$$N\left\{\begin{matrix}(CH_3)_4\\I_{10}\end{matrix}\right.$$

It is possible, however, it results from such a combination as this—

$$N\left\{\begin{matrix}(CH_3)_4 & (CH_3)\\ & (I_{20})''\end{matrix}\right\}N.$$

In either case, it does not affect the question. As for chlorine, if purely univalent in its functions, what is to become of the following bodies?

$$\underbrace{N\left\{\begin{matrix}(CH_3)_4\\ICl_2\end{matrix}\right. \quad N\left\{\begin{matrix}(CH_3)_4\\ICl_3\end{matrix}\right. \quad N\left\{\begin{matrix}(CH_3)_4\\ICl_4\end{matrix}\right.}_{\text{Chloriodides.}} \quad \text{(Weltzien).}$$

It is evident their constitution is similar to that of the iodides. A few instances of double chlorides will further strengthen the evidence of triad character, *e.g.*—

$$KCl+HgCl = KHg.(Cl_2''')''$$
$$KCl+ICl_3 = K.(ICl_4)'$$
$$NaCl+PtCl_2 = NaPt''.(Cl_3)'''$$
$$NH_4Cl+AgCl = (NH_4)Ag.(Cl_2)''$$

Bromine is no exception; but fluorine I am inclined to believe to be a dyad, as suggested by Mr. Gore.†

* Canizzaro.
† Wurtz ("Philosophie Chimique").

* The word molecule I use to signify a group of atoms merely.
† *Proceedings of the Royal Society*, 1869.

If H and Cl be monad elements, in combination they will completely saturate each other; how comes it, then, that a completely saturated compound should unite with H_3N, a ready-formed molecule? These weaker atom-fixing powers of the nitrogen must have the power of splitting up the HCl, in order, first, to fix the atom H, and then the Cl to it; again, at a temperature of 300° C., or thereabouts, ammonium-chloride parts with HCl, again unchanged.

Now, if the constitution of sal ammoniac be—

$$N\left\{\begin{matrix} H \\ H \\ H \\ H \\ Cl \end{matrix}\right.$$

It is only reasonable to expect that heat would drive off, first, either the chlorine or the hydrogen, in which case Pebal, in his experiments proving dissociation, would have found free chlorine: but no; we find the H and Cl coming off in combination. Consider chlorine from the new point of view, and chloride of ammonium like the cyanide, and then how plain is everything—$(NH_3)''$. $(HCl)''$. NH_3 and HCl are both divalent molecules: they combine and separate without disturbance. The following are parallel cases:—

$$N^{v}\left\{\begin{matrix} H \\ H \\ H \end{matrix}\right. = NCH \qquad P^{v}\left\{\begin{matrix} Cl \\ Cl \\ Cl \end{matrix}\right. = Cl_3 \qquad N^{v}\left\{\begin{matrix} H \\ H \\ H \end{matrix}\right. = HCl$$

$$^{*}\,P^{v}\left\{\begin{matrix} Cl \\ Cl \\ Cl \end{matrix}\right. = (MeCy) \qquad P^{v}\left\{\begin{matrix} Cl \\ Cl \\ Cl \end{matrix}\right. = (C_2H_5Cy) \qquad P^{v}\left\{\begin{matrix} Cl \\ Cl \\ Cl \end{matrix}\right. = C_6H_5Cy$$

We have no such easy separation of ammonia from its combinations with oxyacids; from phosphoric acid, a red heat is necessary to remove it; the nitrate decomposes in nitrous oxide and water, &c. On the other hand, another halogen salt, the iodide, decomposes at ordinary temperatures. A further illustration of the same decomposition, giving rise to an anomalous vapour density, is furnished by the bromhydride of amylene, $(C_{10}H_{10})''.H\,Br.''$

As further evidence that various chlorides are not saturated compounds, and thus resemble hydrochloric acid, although the metallic or other radicles are combined with chlorine to their greatest extent, I will quote a few examples of nitriles united with chlorides:—

$Ti\,Cl_4.\,HCN.$†	$Ti\,Cl_4.MeCy.$§	$Ti\,Cl_4.EtCy.$
$Sn\,Cl_4.2HCN.$‡	$Sn\,Cl_4.MeCy.$	$Sn\,Cl_4\,EtCy.$
$Sb\,Cl_5.3HCN.$‡	$Sb\,Cl_5.MeCy.$	$Sb\,Cl_5.EtCy.$
$Fe_2Cl_3.2HCN.$‡	$Fe_2Cl_3\,MeCy.$	$Fe_2Cl_3\,EtCy.$
	&c., &c.	&c., &c.

$Sb\,Cl_5.CyCl.$‡
$Bo\,Cl_3.CyCl.$ (Martius.) $EtCy.CyCl.$
$Fe_2Cl_3.CyCl.$‡
$Ti\,Cl_4.CyCl.$

London, Feb. 24, 1870.

* Henke (*Ann. der Chem. und Pharm.*, vol. cvi., p. 272).
† Wohler (*Ann. der Chem. und Pharm.*, vol. lxxiii., p. 226).
‡ Klein (*Ann. der Chem. und Pharm.*, vol. lxxiv., p. 86).
§ Henke (*Ann. der Chem. und Pharm.*, vol. cvi., p. 280).

ON THE

ACTION OF SODIUM ON ACETIC ETHER.

BY J. ALFRED WANKLYN.

In reply to Frankland and Duppa's note on this subject, read before the Royal Society on Thursday last, I wish to point out that, in addition to the obvious source of fallacy arising from the presence of alcohol in the acetic ether taken for experiment, there is another fallacy depending upon the production of alcohol by secondary action during the course of the experiment. This secondary action consists in the now well-known reaction between acetic ether and ethylate of sodium, whereby acetate of ethylene-sodium and alcohol are formed. If the details of Frankland and Duppa's paper be examined, it will be found that they have given no adequate proof of the original purity of the acetic ether employed by them, and that they have operated under conditions eminently favourable for the production of alcohol by action of acetic ether on the ethylate of sodium, which is an admitted product of the action of sodium on the ether. The high temperature (130° C. they tell us) and the great length of time taken for the experiment, viz., several days, afford these favourable conditions.

I have no doubt that every trace of hydrogen obtained by Frankland and Duppa proceeded from alcohol.

The explanation which these chemists have offered in order to account for my not getting hydrogen, will, I think, not find general acceptance. In the instance of acetate of amyl, which did not give a trace of gas, I operated under little more than ordinary atmospheric pressure, for this ether boils at 140° C., and I heated only to 100° C. And, finally, I found that potassium dissolves without effervescence in pure acetic ether contained in an open vessel at ordinary atmospheric pressure. In 1840, Löwig published a similar assertion on the action of potassium on acetic ether.

ON THE

REACTION OF CHLORINE ON SULPHUR SALTS.*

The following experiments, made some years ago in the laboratory of Owen's College, under the superintendence of Dr. Roscoe, may be of some interest as bearing on the action of chlorine and its congeners on the sulphur-acids.

In order to see how far the action of equivalent quantities of chlorine, bromine, and iodine on the same sulphurous-acid solution are comparable, solutions were prepared, one containing 5 grms. of iodine per litre, and the other such a quantity of sulphurous acid that a litre represented about 150 c.c. of the iodine solution. The exact relation between the two was determined before and after each set of experiments; and it was found that no appreciable alteration took place during the duration of any one set of experiments. A solution of washed chlorine in distilled water was also prepared, and kept in the dark, and, when required, diluted with distilled water to the required strength. The stronger solutions were weighed out in sealed glass bulbs, subsequently broken under the surface of the liquids to be acted on.

(*a*). Known quantities of chlorine solution were added to a measured column of sulphurous-acid solution, the latter being in slight excess. This excess was then titrated by the standard iodine solution.

(*b*). Cl solution was added to potassium-iodide soln-

* Read before the Newcastle-on-Tyne Chemical Society, Feb. 24th, 1870, continued from last number.

tion, and the liberated iodine treated as the chlorine in (*a*).

(*c*). Carried out as (*b*), but potassium bromide used instead of iodide.

(*d*). Bromine liberated, as in (*d*), by Cl and KBr; KI then added, and the iodine thus liberated by bromine treated as that obtained in (*b*).

By subtracting from the iodine solution equivalent to the sulphurous acid used that required for the back titration, numbers were obtained representing the amount of iodine solution equivalent to sulphurous acid destroyed by chlorine, bromine, or iodine in these experiments. Each determination was done in duplicate, frequently in triplicate; and it is noticeable that, whilst the repetitions agreed remarkably closely in all cases where iodine acted on sulphurous acid, they usually showed some little divergence in the case of bromine, and considerably more in the case of chlorine.

Care was taken in all these comparative experiments to have the total volume of liquid in each case as nearly as possible proportionate to the quantity of chlorine originally employed, so that the circumstances of dilution in any set of experiments should be approximately uniform.

The following examples show the character of the numbers obtained, the same measured volume of chlorine solution, containing 0·88 grms. of Cl per litre, being used in each instance.

Iodine representing SO_2 destroyed by I (liberated by Cl and KI).	Iodine representing SO_2 destroyed by I (liberated by Cl and KBr, and by Br thus set free, and KI).	Iodine representing SO_2 destroyed by Cl.	Iodine representing SO_2 destroyed by Br.
c.c.	c.c.	c.c.	c.c.
63·1	62·8	61·6	62·7
62·9	62·6	61·3	62·6
63·1	62·7	60·9	62·7
Mean 63·0	62·2	61·3	62·7

Similarly, with other chlorine solutions, the following mean numbers were obtained from eighteen determinations:—

Grms. of chlorine per litre of solution.	Iodine representing SO_2 destroyed by I (from Cl and KI).	Iodine representing SO_2 destroyed by Cl.	Iodine representing SO_2 destroyed by Br.
*7·00	49·8	44·5	51·3
0·30	57·0	56·5	56·9

The above numbers, calculated in each case to 100 parts of iodine, representing SO_2 destroyed by I (Cl and KI), are—

Grms. of Cl per litre of solution.	Iodine representing SO_2 destroyed by I (from Cl and KI).	Iodine representing SO_2 destroyed by I from Cl and KBr, and from this B and KI).	Iodine representing SO_2 destroyed by Cl.	Iodine representing SO_2 destroyed by Br.
7·00	100·0	—	89·2	103·0
0·88	100·0	99·5	97·1	99·5
0·30	100·0	—	99·2	99·9

It thus appears that the action of iodine is nearly the same, whether directly set free by Cl, or liberated by the circuitous process of evolving bromine from Cl and KBr, and then causing this bromine to act on KI, since the numbers obtained are no more different than might be anticipated from the combined effects of experimental errors, volatility of bromine, &c.; whilst the action of bromine in the two weaker solutions appears to be nearly the same as that of iodine; whereas, in the stronger solution, a larger quantity of SO_2 is destroyed by bromine than by iodine. Lastly, the action of chlorine appears, in the weakest solution, to be nearly identical with that of iodine, but, in the stronger solutions, differs considerably therefrom, and this difference, unlike that in the case of bromine, indicates a destruction of *less* SO_2 by chlorine than by an equivalent quantity of iodine.

From a similarly-conducted series of twenty-four determinations, the following mean numbers were also obtained as the relative actions of chlorine and iodine solutions:—

Grms. of Cl per litre of solution.	Iodine representing SO destroyed by I from Cl and KI.	Iodine representing SO_2 destroyed by Cl.
4·40	100·0	94·7
2·41	100·0	95·4
1·39	100·0	114·4
0·94	100·0	105·4

Experiments were also performed with gaseous chlorine. A known weight of potassium dichromate was treated with hydrochloric acid, in Bunsen's apparatus, and the liberated chlorine led directly into a known slight excess of sulphurous-acid solution, subsequently titrated back by the standard iodine. The iodine solution having been originally standardised from the amount of iodine set free by making the chlorine from a known quantity of dichromate act on potassium iodide, the relative actions of chlorine and iodine were directly calculable. In three experiments, the following numbers were obtained:—

Grms. of chlorine evolved per litre of sulphurous-acid solution employed.	Iodine representing SO_2 destroyed by I (from Cl and KI).	Iodine representing SO_2 destroyed by gaseous Cl.
0·36	100·0	109·8
0·33	100·0	113·0
0·33	100·0	112·8

It is clear, from the above-described experiments, that the difference in the action of chlorine and iodine does not depend solely on the strength of the solutions used. Probably temperature and photo-chemical action are also concerned.

Assuming that the action of iodine on sulphurous acid, under the circumstance experimented on, is always represented by the equation $H_2SO_3 + H_2O + I_2 = 2HI + H_2SO_4$, it is evident that chlorine or bromine *might* cause the destruction of *more* SO_2 than corresponds to this equation, if their actions caused the formation of thionic acids. Thus, for tetrathionate, which as the preceding experiments show, is only slowly acted on by iodine,

$$7H_2SO_3 = \underset{\text{Tetrathionic acid.}}{H_2S_4O_6} + 3H_2O + 3H_2SO_4.$$

But how it happens that a *less* quantity of SO_2 is sometimes destroyed by chlorine than by the equivalent amount of iodine is more difficult to explain. Possibly, though this does not seem a very probable supposition, under the influence of light or of other unknown circumstances, free oxygen may be found which escapes without exerting its due influence on the sulphurous acid—

$$2H_2O + 2Cl_2 = 4HCl + O_2.$$

That free oxygen in aqueous solution acts compara-

* Nearly saturated Cl solution, containing, at 0°, 2·2 vols. of Cl gas to 1 vol. of water.

tively slowly, at any rate in the dark, on sulphurous acid solution, is shown by the following numbers:—A quantity of saturated sulphurous acid solution was largely diluted with water, saturated with air, and kept in a well-closed opaque vessel. Samples, taken from time to time, indicated that the oxidising action of the dissolved oxygen lasted a considerable time, eighteen hours elapsing before the action became negligible; thus, a given volume (stoppered vessel containing about 300 c.c.) required—

Immediately after mixture			.....	42·3 c.c. of iodine solution.	
10 minutes	"	"	.....	40·6 "	"
20 minutes	"	"	.....	40·3 "	"
1 hour	"	"	.....	40·0 "	"
2 hours	"	"	.....	39·9 "	"
18 hours	"	"	.....	39·3 "	"
40 hours	"	"	.....	39·2 "	"

However, the following experiments indicate that, when the action of chlorine or sulphurous takes place without exposure to daylight, the quantity of acid destroyed is always in excess of that due to the equivalent amount of iodine. The previously-described experiments were performed in the diffused light of a laboratory; but the subsequent ones were all carried out in a cellar only lighted artificially—even the weighings of the chlorine solution being performed there, in order to avoid any possible photo-chemical action.

Weighed bulbs of chlorine solution were broken under known volumes of sulphurous acid, diluted the instant previously with warm or cold water, so as to obtain varying temperatures, and similar determinations were made by breaking chlorine water bulbs under potassium iodide solution at varying temperatures.

From twelve determinations, the following mean numbers were obtained:—

Iodine and Sulphurous acid.		Chlorine and Sulphurous acid.		
Temperature.	Iodine representing SO_2 destroyed by I.	Temperature.	Iodine representing SO_2 destroyed by Cl.	Ratios.
14°	104 c.c.	16°	132 c.c.	100 to 127
40°	105 "	35°	186 "	100 to 177

It thus appears that, while variation of temperature makes but little alteration in the action of iodine, it has a great influence on that of chlorine, the difference being the higher the temperature, and always indicates the destruction of more SO_2 by chlorine than by iodine.

To find if the action of chlorine and iodine becomes identical at 0° with any strength of chlorine solution, bulbs containing chlorine water of varying strengths were broken.

(*a*). Under known volumes of sulphurous acid solution at the temperature of the cellar (viz., 12° C. throughout this set of determinations).

(*b*). Under sulphurous acid cooled to 0° by additions of fragments of pure ice (found to have no effect when melted on the iodine solution).

(*c*). Under potassium iodide at 12° and at 0°: the obtained at these two temperatures never differed by more than 0·1 c.c. from one another (out of 40—50 c.c. used).

The following mean numbers were got from thirty-three determinations:—

Grms. of Chlorine per litre of solution.	Iodine representing SO_2 destroyed by I (from Cl and KI).	Iodine representing SO_2 destroyed by Cl at 12° C.	Iodine representing SO_2 destroyed by Cl at 0° C.
*7·20	100·0	106·1	103·4
0·68	100·0	102·5	103·9
0·78	100·0	103·3	102·6

It thus appears that at 0° there is little difference between the action of a saturated solution of Cl and one containing only about one-ninth of that amount.

These experiments would tend to show that, when the action of chlorine or sulphurous acid takes place, not under the influence of light, a larger quantity of acid is destroyed than corresponds to the equation—

$$H_2SO_3 + Cl_2 + H_2O = 2HCl + H_2SO_4,$$

this extra amount varying with the temperature, and, possibly, with the strength of the solution; whilst, if the action takes place in daylight, the result is so modified, that sometimes more, and sometimes less acid is destroyed than that indicated by this equation. In the case of bromine, also, apparently, there is some irregularity in the action under different circumstances, as is shown by the non-uniform results obtained on repetition of determinations. Iodine, on the other hand, as Bunsen has shown (*Ann. der Chem. und Pharm.*, vol. lxxxvi., p. 265), acts with great regularity and uniformity in accordance with this equation under considerably varied circumstances, unless a solution containing more than 0·4 grms. of SO_2 per litre be used.

* Nearly saturated chlorine water.

ON SOME NEW SULPHO-COMPOUNDS.

BY S. E. PHILLIPS.

If botanists were to exercise little or no discrimination between natural and aberrant or monstrous forms, we should make but little progress in the very interesting but difficult problem of botanical arrangement and classification. But chemists are perpetually giving us the most puzzling problems; and their accumulation has landed us in a jargon of types and nomenclature utterly bewildering.

It is in this way M. Schneider has just treated us to some new sulpho-saltic types. Hence the following list (see Chemical News, vol. xx., p. 264; *Am. Repr., Jan.* '70, *page* 51):—

1. Sulphide of silver and iron.....$Ag_2Fe_2S_4$
2. " " iron and sodium.....$Na_2Fe_2S_4$
3. " " bismuth and sodium.....$Na_2Bi_2S_4$
4. " " copper and potassium.....$K_2Cu_8S_6$
5. " " copper and sodium.....$Na_2Cu_8S_6$
6. " " copper, iron, and potassium.....$K_2FeCu_3S_4$
7. " " copper, iron, and sodium.....$Na_2FeCu_3S_4$

We thank him very much for not giving us the rational types of this curious assemblage; whether they are modified types of water or hydrochloric acid, or represent of these arch-types, single, double, or multiple atoms; these are curious points that do not disturb an old chemist. Hence we proceed at once to see how far the old views and intelligible principles may cover the new ground.

The first two would seem to be the most normal form of sulpho-salts for such feeble acid-radicals as copper and iron. The type is a most familiar one, and has a wide range in mineral chemistry. It is that of the corresponding oxy-ferrates and oxy-aluminates—

$$MO + Al_2O_3$$
$$MO + Fe_2O_3$$
$$MS + Fe_2S_3$$
&c.

No. 3 is a simpler form—$NaO + BiO_3$ or $NaS + BiS_3$. The others are more complex, or, at any rate, more unusual, if not hybrid and abnormal.

No. 4 is an utter puzzle, and there is probably some mistake in the figures; or is it possible that any of the varied forms of modern type could resolve such an assemblage of elements?

Nos. 5, 6, and 7 may prove varied or hybrid forms of the common sesqui-type above. This hybridity (or by whatever name it should be called) assumes three forms—

First, in No. 5, one S is replaced by one Cu, a most unusual, but perhaps not an impossible, anomaly. As such, it would be $NaS + CuS_2Cu$. This may appear to some a large measure of faith in the preservation of a generic type; but, on the other hand, it must be observed that this type is well and widely established, and it is only mooted *pro tem.*, until some modern view can supersede it in consistency and simplicity.

Nos. 6 and 7 may be varieties which have two characteristics. The first is a common one, in illustration of which thousands of cases might be cited where Fe replaces Cu, to the preservation of the same type and general properties.

The second one is forced alike upon the attention of old and new chemists, and perhaps has not received that careful attention it so well deserves, though, in some respects, it has been seized hold of and treated as if it were a special part of modern chemical philosophy. I allude to the hypothesis that the ordinary sesqui-sulphide of copper, in these two cases, is a sulphide where two ordinary atoms have a double condensation, and act and re-act as one element. The type of these two bodies would be thus—

$$\left.\begin{array}{l} KS + Cu_2S_3 \\ NaS + \underline{Cu_2}S_3 \end{array}\right\} \text{Cu}_2 = (Cu_3Fe).$$

As modern chemists have perhaps unwisely abandoned the method of indicating the doubled atoms by a cross-line (thereby occasioning great trouble and perplexity to some who either do not or will not understand the new arrangements), I have here adopted it with a new signification. It bespeaks a molecule of double condensation, but which is not a dual in the modern acceptation—viz., it does not represent the equivalence of 2H, &c. The underlining is a convenient way of referring any common type to a marginal explanation.

The entire philosophy of allotropic or isomeric variation will not be fully embraced by any one feature, but this one has powerfully struck the writer in the course of study for many years past. It seems to take place with both elements and compounds; and one of the earliest instances probably on record, is that of (CO) = 14 (the radical of carbonic acid) and (CO) = 28 (the radical of oxalic acid), both of which represent 1 atom of H or other equivalent in a variety of substitutional type modifications. We have HH_2,N (ammonia); and, by a generic reaction, carbonic acid gives $(CO)H_2,N$ (carbamide); and, similarly, oxalic acid gives $(CO)H_2,N$ (oxamide), &c., all normal 2-vol. compounds. And these, by a further extension of the same reaction, give carbamic and oxamic acids, &c.

The ammonia and atmonia type affords a striking illustration: it is as if ammonia, $(H_3N) = 17$, by an allotropic or double condensation, gave atmonia, $(H_3N = 34$; both interchangeably representing one constituent and one vol. in a wide series of combinations.

The precise case here given is, as yet, hypothetical; but the facts are wide and well-known in great extensions.

Ammonia,	HH_3,N	Oxide of ammonium,	HH_3N,O
Ethylia,	EH_3,N	" " ethylium,	EH_3N,O
Urea,	$(CO)_2H_4,N_2$	" " urea,	$(CO)_2H_3N_2,O$
		&c.	

Whatever the future may unfold in regard to this isomeric condensation, one thing at least is certain—that copper was one of the first elements to force it upon the attention of chemists.

As we have MnO_3 and Mn_2O_7,
So we have NH_3 and N_2H_7;

Such being an old and familiar transitional arrangement *within prescribed limits* of mineral chemistry, the first being a ratio of one to three, the second that of one to three-and-a-half.

If old mineral chemistry has lighted up the path into the profounder depths of organic chemistry, truly may we say she is likely to be repaid with a mighty interest of reflex light and illumination.

It only remains to compare the percentage composition of the old and new types—

		NEW.		OLD.		
1.	Sulphide of silver and iron	Ag_2 47·38	47·38	Ag	$= AgS + Fe_2S_3$	
		Fe_2 24·56	24·56	Fe_2		
		S_4 28·06	28·07	S_4		
2.	" iron and sodium	Na_2 12·43	12·80	Na	$= NaS + Fe_2S_3, HO$	
		Fe_2 31·07	31·28	Fe_2		
		S_4 35·44	35·75	S_4		
		HO 19·58	20·17	HO		
3.	" bismuth and sodium	N_2 7·79	7·79	Na	$= NaS + BiS_3$	
		Bi_2 70·51	70·51	Bi		
		S_4 21·70	21·70	S_4		
4.	" copper and potassium	K_2 10·05	(?)	(?)	(?)	
		Cu_8 65·27				
		S_6 24·68				
5.	" copper and sodium	Na_4 13·84	13·86	Na	$= NaS + Cu_2\underline{S}\,\underline{Cu}$	
		Cu_8 57·29	57·11	Cu_3		
		S_6 28·87	29·03	S_3		
6.	" copper, iron, and potassium	K_2 17·28	10·994	K	$= KS + \underline{Cu_2}S_3$	$\text{Cu}_2 = \underline{Cu_3Fe}$
		Fe 12·38	13·348	Fe		
		Cu_3 40·08	45·108	Cu_3		
		S_4 28·27	30·550	S_3		
7.	" copper, iron, and sodium	Na_2 10·94	13·457	Na	$= NaS + \underline{Cu_2}S_3$	
		Fe 13·32	12·993	Fe		
		Cu_3 43·50	43·871	Cu_3		
		S_4 30·44	29·698	S_3		

[English Edition, Vol. XXI., No. 538, page 123.]

As to the nomenclature, nothing could be plainer: they are sulpho-ferrates, sulpho-cuprates, or sulpho-bismuthates of sodium, &c., corresponding with the oxy-ferrates, cuprates, or bismuthates, where we have agreed, in deference to common usage, that the oxy-prefix shall be understood, though unexpressed.

And, just as a sulphate or ferrate means oxy-ferrate of *an oxide*, so sulpho-ferrate or chloro-ferrate means sulpho-ferrate of *a sulphide* or chloro-ferrate of *a chloride*, the latter prefix being implied in the former.

ON A

NEW METHOD OF SEPARATING TIN FROM ARSENIC, ANTIMONY, AND MOLYBDENUM.

BY FRANK WIGGLESWORTH CLARKE, S.B.

Some time since, happening to notice that the remarkable highly-crystalline precipitate formed by oxalic acid in a solution of stannous chloride was not blackened or otherwise affected by sulphuretted hydrogen, I was led to a series of experiments concerning the action of the above-named acid upon certain metallic sulphides, and obtained the following results.

Both sulphides of tin, if moist and freshly precipitated, are readily decomposed by moderately-long boiling with an excess of oxalic acid, H_2S being given off. The monosulphide is converted into the insoluble, crystalline stannous oxalate; while the yellow disulphide is completely dissolved. The commercial "Mosaic gold," however, seems to be unacted upon by the reagent. In presence of an excess of oxalic acid, tin cannot be precipitated by H_2S.

The sulphides of arsenic, even upon very long boiling with the acid, are almost unattacked. Very minute traces of the metal sometimes go into solution, but may be re-precipitated by a bubble or two of H_2S. Accordingly, the presence even of an enormous excess of oxalic acid does not hinder the precipitation of arsenic as sulphide.

The sulphide of antimony behaves in a somewhat different manner. Although, upon long boiling with oxalic acid, considerable quantities of the metal are taken into solution, yet every trace of it may be re-precipitated by H_2S.

Molybdic trisulphide appears to be wholly unattacked by oxalic acid, even upon very long boiling.

With the sulphides of tungsten I have obtained discordant results. Under certain circumstances, they seem to be wholly insoluble in the acid; while, at other times, they are decomposed completely, and partly taken into solution.

By availing myself of the solubility of the sulphides of tin in oxalic acid, I have been enabled to separate tin perfectly from arsenic and molybdenum, and almost perfectly from antimony. When only arsenic and antimony are to be separated from tin, I find it best to proceed as follows:—To the solution containing the three metals (this solution being prepared in the usual manner for the precipitation of the sulphides) I add oxalic acid, in the proportion of about 20 grms. of the reagent for every gramme of tin, taking care to have the whole so concentrated that the acid will crystallise out in the cold. I then heat to boiling, and pass in sulphuretted hydrogen for about twenty minutes. No precipitate appears at first; but, as soon as the liquid is saturated with the gas, the sulphides of arsenic and antimony begin to fall, and, in a very few moments, are completely thrown down. Then, as usual, the whole should be allowed to stand about half-an-hour in a warm place, before filtering. Every trace of arsenic and antimony is precipitated, so that, in the filtrate from the sulphides, neither of these metals can be discovered by Marsh's test, nor can any antimony-stain be produced with zinc upon platinum. I have carefully experimented to learn whether oxalic acid could interfere with either of these tests, and find that it has not the slightest influence upon them. The sulphide of arsenic is absolutely free from tin; but the antimony always carries down a minute trace of that metal with it: this trace, however, if the operation has been carefully performed, can scarcely be detected, and generally may be ignored with safety. If, however, the greatest accuracy is desired, it may be well to re-dissolve the sulphide of antimony in an alkaline sulphide, decompose the solution with an excess of oxalic acid, boil with a little strong sulphydric-acid water, filter, and add the filtrate to the tin solution previously obtained.

To separate tin from molybdenum, owing to the difficulty of precipitating the latter metal with H_2S, I have been obliged to slightly vary my process. I find that, by adding an alkaline sulphide in excess to a solution containing molybdate, then decomposing the sulphur-salt formed with a considerable quantity of dilute chlorhydric acid, and allowing the whole to stand over night in a warm place, every trace of molybdenum is precipitated. The sulphide thus obtained can be easily washed with a mixture of dilute chlorhydric acid and ammonic chloride. If, now, by this process we throw down tin and molybdenum together, every trace of the former metal may be dissolved out by boiling the mixed sulphides for about three-quarters-of-an-hour with oxalic acid, in the proportions which I have already given. It is best to have present in the solution, while boiling, a little dilute chlorhydric acid.

If antimony, also, is contained in the mixture, it is necessary, just before ceasing to boil, to add to the solution an equal volume of strong sulphydric-acid water, to re-precipitate any of that metal which may have gone into solution. Upon filtering, no molybdenum can be detected in the filtrate by any ordinary tests, and the molybdic sulphide is absolutely free from tin. In all these cases, it is assumed that the tin is in the form of a stannic compound. It must be borne in mind that the lower sulphide of this metal is converted by the acid into an oxalate insoluble in water; but, as the latter dissolves to an almost unlimited extent in dilute HCl, its formation need not interfere with an analysis.

Since the presence of oxalic acid interferes somewhat with the complete precipitation of tin by ordinary methods, I was subjected to some trouble in finding a process for determining that metal after the separation. At last I found it could be thrown down as follows:—The solution, after being rendered slightly alkaline with ammonia, is mixed with enough ammonic sulphide to re-dissolve the precipitate at first formed; an excess of *acetic* acid is added, and the whole allowed to rest several hours in a warm place. *Acetic* acid must be used, for stronger acids would be liable to set free some of the oxalic to re-dissolve the tin. The precipitate, which at first varies from white to pale yellow, rapidly darkens in colour, and seemingly consists of a mixture of oxide and sulphide of tin. It should be washed with a solution of ammonic nitrate, and,

after ignition, is weighed as SnO_2. In two successive experiments, in which I mixed a weighed quantity of tin with unknown proportions of arsenic and antimony, I received of the tin, after making my separation, respectively 99·93 and 99·57 per cent. The loss in the second case was due to my not having allowed the tin-precipitate to settle sufficiently long before filtering—in other words, to incomplete precipitation.

The arsenic and antimony, being in the form of sulphides, may be estimated by any of the ordinary methods. They may be best separated by Bunsen's process with sulphurous acid, which, though far from perfect, is superior to all others. Lensen's method, in which the arsenic is precipitated from the sulphur solution of the two metals as ammonia-magnesian arsenate, is worthless.

A couple of years ago, I made a few experiments upon indirectly determining the proportions of tin and antimony in alloys of the two metals. I oxidised a weighed quantity of the alloy with nitric acid in a porcelain crucible, heated the resulting oxides with ammonic nitrate, and then (regarding the tin as converted into SnO_2, and the antimony into Sb_2O_4) calculated the proportions of the metals from the increase in weight. This method, although by no means giving me accurate results, served very well for rough approximate determinations. I cite it here simply as an easy and convenient process for obtaining a close idea of the constitution of any alloy composed of the two metals. Possibly the metal might be so modified as to give accurate determinations.—*American Journal of Science, Jun.*, 1870.

EXPERIMENTS ON SOME OF THE METHODS FOR EFFECTING THE SEPARATION AND ESTIMATION OF ARSENIC AND COPPER.*

BY E. W. PARNELL.

Probably the oldest and most universal method for effecting the separation of these metals is to treat the mixed sulphides with a solution of an alkaline sulphide, in which the sulphides of arsenic are soluble. Another method is to treat the sulphides with a solution of caustic soda or potash, and conduct a slow stream of chlorine gas into the mixture: the arsenic forms arseniate of soda soluble in water, while the copper is in the form of an insoluble oxide. A third method is to conduct a slow stream of chlorine gas over a mixture of the two metals, sulphides, or otherwise, heated by the flame of a Bunsen's burner: volatile arsenic-chloride is formed, which, when received in water, forms arsenic and hydrochloric acids; the copper remains behind. Another method is to convert all the arsenic into arsenic acid, by treatment with nitric acid or otherwise; add excess of ammonia, and throw down the arsenic as a double arseniate of ammonia and magnesia by the "magnesia mixture;" the copper remains in solution.

The author has attempted to show, by the following experiments, how far accurate results may be obtained by these and other methods of separating the metals, and also by the methods generally used for their estimation.

The Separation of the Metals.

A pure solution of copper was prepared, by dissolving pure, re-crystallised copper-sulphate in distilled water. Pure, freshly-sublimed arsenious oxide was dissolved in a boiling solution of sodium carbonate, to form an arsenic solution. Mixtures of these two solutions were used for experimenting on the methods of separation.

Treatment of the Metallic Sulphides with an Alkaline Sulphide.

A mixture was made from the above solutions, containing about 0·3 grm. of each of the metals. Excess of hydrochloric acid was added, the metals thrown down by sulphuretted hydrogen, the mixed sulphides introduced into a flask, covered with a colourless solution of sodium sulphide, and maintained at a gentle heat on the water-bath for about twelve hours. The liquid was then filtered off, the filtrate separated, and the copper-sulphide on the filter washed with boiling water, to remove every trace of soluble arsenic. The copper-sulphide was then dissolved in nitric acid, the solution evaporated with a small quantity of sulphuric acid, the residue dissolved in water, again treated with sulphuretted hydrogen, the precipitate treated as before with perfectly pure sulphide of sodium, and filtered. The clear solution that would have contained any arsenic that had remained with the copper in the first instance was decomposed with hydrochloric acid, the precipitated sulphur collected, washed, and treated with ammonia, which would dissolve any sulphide of arsenic that might be mixed with it. A little sodium-carbonate was added to the ammoniacal solution, and the liquid evaporated to dryness in a small porcelain dish, the residue mixed with a little potassium cyanide, and the mixture examined for arsenic, by heating it in a glass tube in a slow stream of carbonic acid, in the manner described in Fresenius's "Qualitative Analysis" (German edition, p. 180). A very faint mirror of metallic arsenic was obtained, that could not exceed 1-10th of a milligramme.

The filtrate from the first treatment with sodium sulphide was next decomposed with hydrochloric acid, the precipitate thoroughly washed and dried, and carefully sublimed. No trace of copper remained as a residue. From this, therefore, I conclude that a satisfactory separation can be effected by using a colourless solution of sodium sulphide.

The fact of ammonium sulphide dissolving small quantities of copper sulphide being so well known, the author did not consider it necessary to experiment on this method.

Separation by Conducting Chlorine Gas into an Alkaline Solution in which the Sulphides are Suspended or Dissolved.

A mixture was made, as in the preceding experiment; excess of a solution of potash was added, and a slow stream of chlorine conducted into the liquid until the latter was thoroughly saturated with the gas. The mixture was then boiled, filtered, the insoluble part well washed, and the precipitate and filtrate examined respectively for arsenic and copper, as in the previous examination. The copper was perfectly free from arsenic; but the filtrate contained a small quantity of copper (this was, however, probably due to minute particles of the oxide of copper being carried through the filter, as the oxide was in an exceedingly fine condition: the quantity was very small). Care should be taken to ensure a decided excess of the chlorine, or a considerable quantity of arsenic may remain with the

* Communicated by the Author. Conducted in the Laboratory of Professor Fresenius, Wiesbaden.

copper. I conclude, therefore, that this method can yield accurate results.

Separation effected by Heating the Mixture in a Stream of Chlorine Gas.

A similar mixture to those used in the previous experiments was prepared, excess of hydrochloric acid added, the metals thrown down by sulphuretted hydrogen, the precipitate thoroughly dried and introduced into a bulb-tube, and the separation proceeded with precisely as described in Fresenius's "Quantitative Analysis." A large quantity of copper was found to be carried over with the arsenic into the condensing tube; this would indicate that the heat had been far too high. The next step was to discover at how low a temperature all the arsenic could be decomposed and volatilised. With this object, about 1·0 grm. of pure arsenious trioxide, placed in a small porcelain boat, was introduced into a glass tube; this latter passed through an air-bath, fitted with a thermometer to enable the tube to be maintained at a fixed temperature. A slow stream of chlorine gas was conducted through the tube. In about twenty minutes, the arsenic was entirely converted to an oily-looking, yellow liquid—no doubt the terchloride. The temperature of the bath was then raised to and maintained at 100° C. In about half-an-hour, the liquid was entirely volatilised.

About 1 grm. of sulphide of copper was next treated in a similar manner with a cold stream of chlorine gas. The black mass quickly became yellow. In about an hour it was examined for sulphide, by treating a portion of it with water. A considerable quantity remained undecomposed. The temperature of the bath was then raised to 100 C., and the stream of chlorine conducted, as before, over the mass. After half-an-hour it still contained sulphide. The temperature was then raised to 150° C., and the stream of chlorine continued. After four hours the sulphide was not decomposed. In these experiments, the chlorine gas had not been thoroughly dried by passing it through a tube containing chloride of calcium. It occurred to me, therefore, that the small quantity of moisture the gas would contain might retard its action on the sulphide. To discover if this were the case, a similar quantity was taken, very carefully dried, and treated as before with a stream of the cold, but now thoroughly dried, gas. In about half-an-hour, a portion of the sample was examined for sulphide; it contained only a very small quantity. The action was continued in the cold for about 1½ hours, a minute trace still remained; on warming the tube to about 150° C., and continuing the chlorine stream, this trace quite disappeared.

A mixture of copper and arsenic was then again prepared from the solutions, converted into sulphides as before, filtered, washed, and thoroughly dried. The mixture, contained in a porcelain boat, was introduced into the glass tube. This tube was allowed to project for about 4 inches beyond the air-bath. Perfectly dry chlorine was then conducted over the mixture, maintained at a temperature of about 200° C. In about half-an-hour the action was stopped. The projecting part of the tube, which had been almost cold during the operation, was examined for copper. It contained no trace. The copper in the porcelain boat was found to be completely soluble in weak hydrochloric acid. The solution was precipitated with sulphuretted hydrogen, the precipitate treated with sodium sulphide in a warm place for about four hours, the mixture filtered, and the filtrate carefully examined for arsenic, as before. It did not contain the slightest trace. I gather, therefore, from these experiments that, if proper precautions be taken to ensure perfect dryness of the mixture and the gas, a most perfect separation can be effected at a temperature of about 200° C. To avoid the formation of the globule of sulphur, or mixture of chloride of sulphur and sulphur, which often takes place in the condensing-tube, the precaution should be taken to first saturate the liquid with chlorine, or to use a solution of chlorine for the condensing-liquid.

Separation by Igniting the Mixed Sulphides in a Stream of Hydrogen Gas.

This process, conducted in the usual manner, has only for its object the estimation of the copper, unless, indeed, the amount of sulphur in the mixed sulphides is accurately known, when the amount of arsenic may be calculated from the loss.

To effect the separation, the mixture is introduced into a small porcelain crucible, fitted with a perforated cover and tube for conducting in the gas. A little sulphur is added, a gentle stream of hydrogen conducted into the crucible, and the mixture carefully heated by the lamp, and finally raised to bright redness. A mixture of the two metals was thrown down, as before, with sulphuretted hydrogen, and ignited as just described. The subsulphide of copper was subsequently very carefully examined for arsenic; it did not, however, contain the slightest trace.

Experiments on the Methods for Estimating Arsenic.

About 3·5 grms. of pure, dry arsenious oxide were carefully sublimed in a slow stream of dry air. This re-sublimed arsenious oxide was then weighed (it equalled 2·4090 grms.), and dissolved in a boiling solution of carbonate of soda. I purposed diluting this solution to a certain volume, and measuring off portions for the various estimations. To ascertain the extent of the error that this mode of procedure would introduce, the following experiment was made:—A flask of about 300 c.c. capacity, with rather a narrow neck, was carefully marked, and filled to the mark with distilled water. The water in the flask weighed 281·51 grms. 20 c.c. of the water were then measured off, by a pipette, into a small, weighed beaker. The pipette was allowed to drain for about half-a-minute, resting against the side of the beaker, immediately above the liquid.

The weight of water was found to be—

	grms.
In the first trial.....	20·037
In the second trial.....	20.032
In the third trial.....	20·035
Average of the three trials.....	20·034

The greatest difference was 3 milligrammes, equivalent to 0·015 per cent. The extent of the error was, therefore, exceedingly small. The solution of arsenious oxide was introduced into the flask above mentioned, diluted to the mark on the neck, and the temperature noted. 20 c.c. of the solution contained, therefore, 0·17145 grm. arsenious oxide.

Estimation by Precipitation as Double Arseniate of Magnesia and Ammonia.

This mode of estimating arsenic (and, indeed, most others) necessitates the use of a weighed filter. The filter is first thoroughly dried in the water-bath, and usually allowed to cool between a pair of well-fitting

watch-glasses. In this manner, it is very difficult to get accurate results: though the watch-glasses may fit very perfectly, the weight of the filter will rapidly increase after being taken out of the exsiccator.

To more perfectly protect the filter from external moisture, the holder about to be described was substituted for the watch-glasses. A test-tube of about 18 m.m. diameter was cut off about 10 centimetres from the closed end. A second test-tube was then selected, which fitted tightly over the first. The latter was then melted at a convenient distance from the end, and closed, so as to form a small and almost air-tight cover for the first tube. A dry filter, held in the old manner, between watch-glasses, absorbed, in a few hours, 14 milligrammes; while a filter in the holder described, in the same position, and in the same time, had absorbed only 0·6 milligramme.

Twenty c.c. of the arsenious-acid solution were measured off into a small beaker, neutralised with excess of acid, and chlorine conducted into the solution to strong excess. Ammonia was then added, and the arsenic acid precipitated by the "magnesia mixture," and proceeded with precisely as described in Fresenius's "Quantitative Analysis." The filter and precipitate were dried for two or three hours, at a temperature of 110°.

	grms.
Holder + filter + precipitate weighed....	8·1970
Holder and filter.....	7·8892
Double arseniate.....	0·3078
Correction for filtrate (101 c.c.).....	0·0063
	0·3141
Equivalent to arsenious acid.....	0·1636

A result which is far too low.

Twenty c.c. were treated precisely as before, but with additional care, to ensure the complete oxidation of the As_2O_3 to As_2O_5. The precipitate was dried at 110° C. until the weight remained constant.

	grm.
The precipitate weighed.....	0·3095
Correction for filtrate (93 c.c.).....	0·0058
	0·3153

A result still very much too low.

A third quantity was measured off, and this time was oxidised by conducting chlorine gas into the alkaline solution without addition of hydrochloric acid.

	grm.
The weight of the precipitated arseniate (together with corrections for the filtrate) equalled.....	0·3244
Equivalent to arsenious oxide.....	0·1690

A result still too low.

Another portion was measured off, and proceeded with precisely as the last. The precipitate corresponded to 0·1670 grm. arsenious acid—a result still unsatisfactory.

The irregularity of these results led the author to conclude that either the correction for the filtrate is incorrect, or that the formula $(AsO_4, Mg, NH_4), 2H_2O$ does not represent the composition of the compound after being dried at 100°—110° C. To discover if the former were the case, a filtrate from one of the previous estimations, measuring 76 c.c., was neutralised with hydrochloric acid, and treated at a gentle heat for some hours with a slow stream of sulphuretted hydrogen, until all the arsenic was completely precipitated. The precipitate was filtered off, washed, dried, treated with CS_2 to remove any free sulphur that might be present, and weighed. The weight equalled 0·0019 grm., corresponding to 0·0029 of the magnesia precipitate. The correction usually made (namely, 1 milligramme for every 16 c.c.) would indicate a larger quantity than this, namely, 0·0047 grm.; so that an error from this source would render the result too high, instead of, as the case is, too low.

To discover the composition of the magnesia precipitate after being dried at 110° C., the pure precipitate was prepared in the following manner:—A quantity of pure arsenious oxide was powdered, and treated with strong nitric acid, to convert it into arsenic acid. The acid liquid was neutralised with ammonia, diluted, and precipitated with a solution of magnesium sulphate, care being taken to avoid an excess of the latter. The precipitate was well washed, first by decantation, subsequently on a large filter, with pure distilled water, and then thoroughly dried over sulphuric acid. A portion of it (about 1 grm.), further dried for thirteen hours over sulphuric acid, lost 0·0002 grm.

1·6822 grm. was dried at a temperature of 100° C. for three hours. It lost 0·6319 grm. For two hours longer, it had lost 0·6329 grm. The total loss amounted to 37·62 per cent; theory would lead us to expect only 34·25.

0·6059 grm. was then dried in the water-bath, the temperature of which, however, was not much above 90° C.

	grm.		per cent.
After 12 hours it lost....	0·2020	=	33·34
" 18 " "	0·2036	=	33·59
" 24 " "	0·2054	=	33·80

No further decrease in weight took place.

1·0152 grms. were again heated in the air-bath.

	grm.		per cent.
4 hours at 100°—107° C. lost	0·3745	=	36·88
" " " 105°—110° " "	0·3867	=	38·10
3 " " 105°—110° " "	0·3927	=	38·60

All of which are much above the theoretical loss.

The next step was accurately to ascertain the composition of the precipitate, dried over sulphuric acid. For this purpose, 1·0894 grms. were dissolved in hydrochloric acid, the arsenic precipitated with sulphuretted hydrogen, and filtered off; the filtrate concentrated, neutralised with ammonia, and the magnesia thrown down in the usual manner as a phosphate. The magnesia found equalled 13·92 per cent; the salt should theoretically contain 13·84.

To estimate the amount of ammonia in the salt, 0·2656 grm. was distilled in a small flask with caustic potash, and the escaping ammonia collected in a measured quantity of standard sulphuric acid, the excess of which was subsequently estimated by a standard alkaline solution. The sample contained 8·92 per cent; the theoretical proportion is 8·95 per cent. From these two determinations, I concluded that the formula $PO_4, Mg, NH_4, 6H_2O$ correctly represented its composition.

It is well known that the error caused by heating the sample too highly is due to ammonia which escapes. The next experiment was to discover at what temperature the ammonia commences to be evolved. About 2 grms. of the precipitate, in a small porcelain boat, were introduced into a glass tube, so arranged as to be heated by an air-bath to any desired temperature.

Air was drawn, by an aspirator, first through the tube, and then through a few cubic centimetres of pure water, slightly coloured with neutral litmus. The temperature had not been raised above 80° C., when ammonia manifested itself by changing the colour of the litmus. A weighed quantity was next operated upon, the tube being heated by a water-bath, and the escaping gases conducted through a small quantity of standard sulphuric acid. In about an hour, the sample had lost 5 per cent of ammonia. I therefore conclude that, at a temperature of about 90° C., ammonia escapes, but more than 1 equiv. of water is retained; while, at a temperature of from 100° to 110° C., this excess of water, and probably more ammonia, are driven off; and I therefore consider that no definite compound of arsenic can be obtained by drying the precipitate at a temperature at all suitable for a counterpoised filter. By heating the precipitate strongly to obtain AsO_4,Mg, arsenic invariably escapes. A plan was tried of first evaporating the precipitate with nitric acid before ignition, with a view to form ammonium nitrate, and prevent the reduction of the arsenic; but a loss still took place. Tolerably accurate results may be obtained by dissolving the precipitate in hydrochloric acid, precipitating the arsenic with sulphuretted hydrogen, and weighing it as As_2S_3. The salt, by this method, contained 25·78 per cent, instead of 25·90 per cent. This sulphide cannot be reduced to As_2S_3 by treatment with CS_2, which leads one to conclude that it is a penta-sulphide, and not, as some maintain, a mixture of As_2S_3 and free sulphur.

Estimation of Arsenious Oxide by Precipitation as Sulphide.

Twenty c.c. of the arsenious-acid solution were measured off, neutralised with hydrochloric acid, and the arsenic thrown down as tersulphide by sulphuretted hydrogen. The excess of the latter reagent was expelled by conducting carbonic acid into the liquid. The sulphide was collected on a tared filter, washed, and dried at 100° C. until the weight remained constant. The sulphide weighed 0·2114 grm., equivalent to 0·1701 grm. As_2O_3.

Another 20 c.c. were treated in precisely the same manner. The sulphide weighed 0·2116 grm., equivalent to 0·1703 As_2O_3.

These two results agree together very closely, but are both slightly too low. Probably, if the precaution were taken to avoid a great excess of hydrochloric acid, still more accurate results might be obtained.

The only methods for estimating copper that were experimented on were the well-known plan of precipitating the metal as an oxide by means of a solution of caustic potash or soda, washing well with boiling water, igniting, and weighing; and the plan of igniting either the sulphide or the sulphocyanide with sulphur in a stream of hydrogen gas. The accuracy of the first method is so well established that it is not necessary to give details of experiments. The latter methods also give exceedingly accurate and constant results.

For estimating the amount of arsenic in ores, from the above experiments, I should imagine the neatest, simplest, and most accurate mode of procedure to be to heat the finely-divided sample, in a gentle stream of chlorine gas, to a temperature of about 200° C., and to collect the escaping arsenic-chloride in chlorine-water. If free from antimony, the liquid might be well boiled, to expel free chlorine, and the arsenic precipitated with sulphuretted hydrogen, and weighed as As_2S_3; or it might, perhaps, be better estimated by some volumetric method.

In cases where the arsenic is obtained in the form of $AsO_4,Mg,NH_4,6H_2O$ (as in separations of the metal from antimony or copper), the most accurate plan would be to dissolve the precipitate in hydrochloric acid, and precipitate the arsenic as As_2S_3. When the amount of arsenic is small, it might be weighed as the double arseniate. The sample should not, however, be dried at a higher temperature than that of any ordinary water-bath—namely, about 95° C. Perfectly accurate results could, no doubt, be obtained by drying the precipitate over sulphuric acid, when it retains its 6 equivs. of water. The only objection is that it would take days for a filter containing a precipitate to be properly dried by this means.

Runcorn, March 8th, 1870.

THE "WEAPON-SALVE" OF PARACELSUS.

BY G. F. RODWELL, F.C.S.

Among the more curious of the magical remedies of the sixteenth and seventeenth centuries was a certain ointment, invented by Paracelsus, which, he asserted, would cure all wounds resulting from violence, by being applied to the weapon which had caused the wound (or its facsimile), under certain precise and stringent conditions. The directions which are given for the preparation of this unguent vary slightly, according to different authors. It was to be compounded of moss from the skull of an unburied man, gathered under certain planetary conditions, of oil, "mummy," and human blood, while some recommended the addition of the "dryed brain of a wilde bore." The most minute directions were given for applying the unguent to the weapon, and a slight carelessness could as easily cause the death of the patient as his cure: thus it was said, "Beware that the weapon fall not downe, nor the winde blow upon it in a cold place, for it will force the patient to madness." Many writers wrote strongly in favour of this cure; among them, Crollius, Baptista Porta, Cardanus, Burgravius, and Coclinius. Lord Bacon alludes to it in his "Sylva Sylvarum" (cent. 10, par. 998), and adds, "though myself, as yet, am not fully inclined to believe it." Robert Fludd, a physician, and a contemporary of Bacon, was one of its staunch supporters.

Now, a certain William Foster, "M.A., and Parson of Hedgeley, in the County of Buckingham," who appears to have been fond of controversy, and dissatisfied with his position in the Church, was particularly bitter against this cure, which he verily believed to be the work of the devil. Full of this idea, he published a brochure of fifty-six pages, in 1631, entitled "Hoplocrisma Spongus; or a Sponge to wipe away the Weapon-Salve. A treatise wherein is proved that the cure late taken up amongst us, by applying the salve to the weapon, is magicall and unlawful." In the preface, Foster, in vindication of the violent attack which he made upon the advocates of this cure, says—"I dare call sin, sin in whomsoever. If Jesabell be painted, with Jehu I will not have peace with her to commend her, though a queene. If Herod be incestuous, with the Baptist I'll not sooth him, though a king. If Simon Magus be a socerer, I feare not his divell; with S. Peter, I'll rouze him, though a witch. Shall anyone, for my boldnesse, think to sit upon my skirts? Let these

knowe I esteeme myself *infra invidiam.* I cannot have lesse in the Church, unlesse nothing. And, if they shall endeavour to keep me still low, let them knowe I looke for no good from them that envie my endeavours to do good." Against Fludd, as one of the most recent advocates of the cure, Foster is specially virulent; indeed, the brochure is principally directed at him. At first, Fludd took no notice of the attack, deeming Foster, as he tells us, not worthy of notice; but, finding one morning that Foster had caused a title-page of the "Hoplocrisma Spongus" to be nailed to each of his door-posts, he was so incensed thereby that he forthwith brought out a brochure of 212 pages in reply. It is entitled—"The Squeezing of Parson Foster's Sponge, ordained by him for the wiping away of the Weapon-Salve. Wherein the sponge-bearer's immodest carriage and behaviour towards his brethren is detected; the bitter flames of his slanderous reports are, by the sharpe vineger of truth, corrected and quite extinguished; and, lastly, the vertuous validity of the sponge in wiping away of the weapon-salve is crushed out, and thus abolished." On the title-page, Fludd introduces a verse from the 92nd Psalm concerning the fall of the wicked man, and also the somewhat pointed remark—"Opera Dei, vir brutus et stultus, non intelligit." It is to be confessed, however, that he was a good deal provoked. The manner in which the controversy was continued is somewhat amusing, when we remember the subject of it. Foster, after mentioning several men who had advocated the weapon-salve, and indirectly including Fludd amongst them, says—"I wonder at nothing more than that Beelzebub was not in the number." To which Fludd replies—"A singular diabolical conceit . . . . . Marry, I will tell him why:—If it had been true that the use of the weapon-salve is witchcraft, and the users thereof witches and conjurers (as he boldly saith), how, I pray you, should Beelzebub be missing from our company? . . . And this is the reason that Mr. Foster and his like have failed to find Beelzebub or the Devil in this number, forasmuch as he is nearer to them than they are aware of."

After vindicating himself, and disavowing all connection with magic and necromancy, Fludd attacks certain of Foster's statements in regard to other matters. "I will proceed now," he says, "to the greatest assault, wherein his sponge rubbeth very hard against my text, but prevaileth no more than they which go about to wash away the colour of a black-moore." He then enters into an elaborate statement to prove that "devils have aëry bodies allotted to them in their creation," which Foster had denied. And thus is the foolish controversy continued to the end. The amount of erudition brought to bear upon it is surprising, and worthy of a better theme. An assertion is rarely made on either side without a quotation to back it up, Foster preferring the Fathers of the Church (notably SS. Augustine and Jerome), while Fludd goes back to the ancient Greeks, and to Hermes Trismegistus. They both quote the Scriptures profusely, Foster because he is a clergyman, Fludd because he knows that arguments drawn from that source will most prevail with a Churchman.

We do not hear much more of the weapon-salve. After all, it is scarcely more absurd than some of the beliefs which prevail in the present day in remote country districts—such, for instance, as the cure of warts by rubbing them with a piece of stolen meat. The belief in cures of this nature was rife in the seventeenth century. Bacon asserts many of them. We must remember that the belief in witches and demons, spells, conjurations, philtres, and raisings of the devil, was as firm then amongst all classes of Society as it is now in many a lone hamlet in Cornwall, and many a green village of Galway or of Wales. Of necessity, superstition lingers longest in those places which are most removed from centres of thought and civilisation. There is a conservative attitude of idea about people who are much shut out from the external world. We know a village not two hundred miles from London (which there is no reason to believe differs from other villages distant from large towns) in which there are many Middle-Age superstitions; there is a witch, moreover, who possesses the power of the evil-eye, and those who offend her are sure to suffer, sooner or later, some dire calamity; we have not yet heard of her raising a familiar demon. Now, all this goes on in a village by no means debarred from the progress of civilisation; there is a boys' school with a certificated master, a girls' school with a certificated mistress, a night-school, a Sunday-school, penny-readings, and occasional concerts, not to speak of a really good village-library. If, then, in this nineteenth century, all manner of rank superstitions are among us (and we have most of us some pet superstition or other), we can scarcely cry shame on the advocates of the weapon-salve two centuries and a half ago. As for Parson Foster, of Hedgeley, he was certainly a man born out of due time.

QUICK WET ASSAY OF GALENA AND OTHER COMPOUNDS OF LEAD.*

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When in contact with metallic zinc, galena is readily decomposed by acids. Even oxalic, acetic, and dilute sulphuric acids are capable, when hot, of decomposing galena,—metallic lead being deposited and sulphuretted hydrogen gas set free,—while with chlorhydric acid the decomposition is peculiarly rapid and complete.

Galena is easily decomposed, also, even in the cold by dilute nitric acid in presence of zinc; but the reaction differs in this case from that just described—not metallic lead but free sulphur is deposited, while nitrate of lead goes into solution.

The reaction with zinc and chlorhydric acid may be employed with advantage for assaying galena, particularly the common American variety, which contains no other heavy metal besides lead. The details of the process are as follows:—Weigh out 2 or 3 grms., or more, of the finely powdered galena. Place the powder in a tall beaker, together with a smooth lump of pure metallic zinc. Pour upon the mixed mineral and metal 100 or 150 c.c. of dilute chlorhydric acid which has been previously warmed to 40° or 50° C.; cover the beaker with a watch glass or broad funnel, and put it in a moderately warm place.

Chlorhydric acid, fit for the purpose, may be prepared by diluting 1 volume of the ordinary commercial acid with 4 volumes of water. For the quantity of galena above indicated, the lumps of zinc should be about an inch in diameter by a quarter of an inch thick; they may be readily obtained by dropping melted zinc upon a smooth surface of wood or metal.

The zinc and acid should be allowed to act upon the

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* Communicated by the Author.

mineral during fifteen or twenty minutes in order to ensure complete decomposition. Any particles of galena which may be thrown up against the cover or sides of the beaker should, of course, be washed back into the liquid. It is well, moreover, to stir the mixture from time to time with a glass rod.

When all the galena has been decomposed, as may be determined by the facts that the liquid has become clear, and that no more sulphuretted hydrogen is evolved, decant the liquid from the beaker into a tolerably large filter of smooth paper, in which a small piece of metallic zinc has been placed. Wash the lead and zinc in the beaker as quickly as possible with hot water, by decantation, until the liquid from the filter ceases to give an acid reaction with litmus paper; then transfer the lead from the beaker to a weighed porcelain crucible. In order to remove any portions of lead which adhere to the lump of zinc, the latter may be rubbed gently with a glass rod, and afterwards with the finger or a piece of caoutchouc, if need be. Wash out the filter into an evaporating dish, remove the fragment of zinc, and add the particles of lead thus collected to the contents of the crucible. Finally, dry the lead at a moderate heat in a current of ordinary illuminating gas, and weigh.

The lead may be conveniently dried by placing the crucible which contains it in a small cylindrical air-battery of Rammelsberg's pattern, provided with inlet and outlet tubes of glass, reaching almost to the bottom of the bath.

When the process is conducted as above described, the lead undergoes no oxidation; hence there is no occasion for igniting the precipitate in a reducing gas. The precipitate needs only to be dried out of contact with the air.

If desirable, the sulphur in the galena could be determined at the same time as the lead, by arresting the sulphuretted hydrogen in the ordinary way.

If the mineral to be analysed is contaminated with a siliceous or other insoluble gangue, the metallic lead may be dissolved in dilute nitric acid, after weighing, and the insoluble contamination collected and weighed by itself. In the case of galenas which contain silver, antimony, copper, or other metals, precipitable by zinc, the proportion of each metal must be determined by assay or analysis in the usual way after the total weight of the precipitated metals has been taken.

Besides galena, almost any of the ordinary lead compounds may evidently be assayed by the method above described. I find, for example, that metallic lead may be precipitated quickly and completely from the sulphate, chromate, nitrate, oxide, and carbonate—and with peculiar ease from the chloride—by means of zinc and chlorhydric acid. The method would furnish an easy qualitative test for the detection of barytes in white lead. When applied to the analysis of nitrate of lead, it would probably be best to decompose the nitrate by means of a solution of chloride of sodium before adding the zinc and chlorhydric acid.

In all these cases the decomposition of the lead salt by the zinc is so complete, that no trace of colouration is produced when sulphuretted hydrogen is added to the liquid decanted from the metallic lead.

The following determinations of lead in a sample of pure galena from Galena, Illinois, were made in the manner above described by my assistant, Mr. A. H. Pearson:—

	Grammes of galena taken.	Grammes of lead found.	Per cent of lead found.	Theory.
No. 1.	1·4847	1·2908	86·93	86·62
" 2.	0·5902	0·5120	86·75	
" 3.	3·6320	3·1568	86·91	

Attempts to determine sulphur and lead in the same portion of galena, by means of the reaction of zinc and dilute nitric acid, above described, gave no satisfactory results. The free sulphur obtained by treating galena with zinc and ordinary nitric acid, diluted with 3, 4 and 5 volumes of water, always retained a small quantity of lead, while a certain amount of sulphuric acid was found in the clear liquid. It is, in short, well nigh, or quite, impossible to avoid the secondary reactions between zinc and nitrate of lead, and between sulphur and nitric acid which set in as soon as, or just before, the last traces of the galena have been decomposed.

Boston, Feb., 1870.

ON THE ESTIMATION OF AMMONIA IN ATMOSPHERIC AIR.*

BY HORACE T. BROWN.

In the attempts that have been hitherto made to estimate the ammonia present in atmospheric air, the results arrived at by the various experimenters have differed so widely that it is still a matter of uncertainty what the quantity really is. That it is a very small amount all agree, but the extreme results on record vary as much as from 13·5 to 0·01 part of carbonate of ammonium per 100,000 of air. It may, therefore, not be without interest to give an account of a simple method affording very concordant and, I believe, accurate results; at the same time being easy of performance and requiring but little time for an experiment.

The apparatus used consists of two glass tubes, each of about 1 metre in length and 12 m.m. bore. These are connected air-tight by means of a smaller glass tube, and inclined at an angle of 5° or 6° with the horizon. Into each of the larger tubes are introduced 100 c.c. of a mixture of perfectly pure water and two drops of dilute sulphuric acid (sp. gr. 1·18). Through this acidulated water a measured quantity of the air under examination is slowly drawn, in small bubbles, by means of an aspirator.

No porous substance must be used to filter the air, for reasons to be stated hereafter. The air is conducted into the absorption liquid through a small piece of quill tubing drawn out to a small aperture at the end, immersed. This tube must be kept quite dry throughout the experiment. Great care must be taken to cleanse perfectly every part of the apparatus with water free from ammonia, and the caoutchouc plugs, or corks, used must be boiled for a short time in a dilute solution of caustic soda.

The stream of air is so regulated as to allow about 1 litre to pass through the apparatus in an hour.

By directing the point of the delivery-tube laterally, each bubble has imparted to it on rising an oscillatory movement, which facilitates complete absorption of the ammonia.

When from 10 to 20 litres of air have passed, the liquid is emptied from the tubes into upright glass cylinders, an excess of a perfectly pure solution of potash added, and then 3 c.c. of a Nessler solution. The standard of comparison is made in the ordinary way, only using acidulated in place of pure water, and neu-

* A paper read before the Royal Society, March 17, 1870.

[English Edition, Vol. XXI., No. 539, pages 137, 138.]

tralising with potash after adding the standard solution of ammonium salt. Beyond somewhat retarding the point of maximum colouration, a little potassium sulphate does not interfere with the delicacy of Nessler's reaction.

If the experiment has been conducted with proper care, at least four-fifths of the total ammonia ought to be found in the first tube. Four or five litres of air are generally quite sufficient to give a decided reaction, but it is better to use not less than 10 litres, as before mentioned.*

Very many experiments have been made by this method, both on air from the town of Burton-on-Trent, and that of the adjoining country. The air from the town, as might be expected, varies somewhat in composition; much more so than that taken from the open country, as may be seen from the following tables, in which are given some of the numerous results obtained.

The ammonia is calculated in every case as carbonate [$(NH_4)_2CO_3$]; for although nitric acid is sometimes found in air, yet its presence must be looked upon as accidental.

In the immediate vicinity of towns, some of the ammonia must also be in the form of sulphate, sulphite, or ammonium chloride.

(1). *Air taken from town.* (Taken at a height of 2 metres from ground.)

Date of Experiment.	$(NH_4)_2CO_3$ as grammes per 100,000 litres of air at 0° C. and 760 m.m. barom.	$(NH_4)_2CO_3$ in parts by weight per 100,000 of air.
1869. Sept. 30	1·12940	0·8732
Oct. 4	0·62117	0·4801
" 6	0·52510	0·4059
" 8	0·62117	0·4801
Nov. 26	1·07290	0·8293
" 28	1·10000	0·8503

(2). *Air from country.* (Taken at a height of 2 metres.)

Date of Experiment.	$(NH_4)_2CO_3$ as grammes per 100,000 litres of air at 0° C. and 760 m.m. barom.	$(NH_4)_2CO_3$ in parts per 100,000 of air.
1869. Dec. 6	0·7620	0·5890
" 8	0·7826	0·6085
" 9	0·6601	0·5102
" 11	0·6635	0·5121
1870. Feb. 12.	0·7639	0·5904

The direction of the wind does not seem to have any influence on the ammonia found; immediately after heavy rain, however, the quantity falls somewhat below the average, but the air is again restored to its normal condition after a lapse of two or three hours.

Attempts were made to make the method more delicate still by absorbing the ammonia in pure water and then distilling, but the nitrogenous organic matter suspended in the air was found to interfere with the results.

When the air is passed through cotton-wool before entering the absorption-tubes, it is found to be entirely deprived of its ammonia by the filter. This is also the case with air artificially charged with ammonia *to a large extent.* This absorption is not due to the presence of hygroscopic moisture, since cotton-wool, when absolutely dry, is capable of taking up 115 *times its own bulk* of dry ammonia (confined over mercury) at 10·5° C. and 755·7 millims. barom.; the gas being again slowly evolved when the wool is left in contact with the air at 100° C.

All other porous substances that were tried for filtering agents were found to possess this property more or less; even freshly ignited pumice-stone is not entirely without absorptive effect upon the gas.

* When the air to be examined is highly charged with ammonia, as that from stables, &c., a perfectly dry bottle of 3 or 4 litres capacity should be carefully filled with a pair of bellows, 100 c.c. of acidulated water introduced, and, after closing securely, the whole well agitated at intervals for three or four hours. The liquid is then poured out, and the NH_3 estimated by the Nessler solution as usual.

REPORTS OF SOCIETIES.

CHEMICAL SOCIETY.

February 17th, 1870.

Dr. A. W. Williamson, F.R.S., &c., *President, in the Chair.*

The following gentlemen were elected Fellows:—R. T. Atcherley, T. W. Axe, A. H. Bateman, E. Francis, A. Prangley, W. Pritchard, L. B. Ross, T. G. Rylands, T. Wills, P. Wright.

An account was given by Professor Tyndall of his researches on "*The Action of Light on Gases and Vapours,*" illustrated by a series of beautiful experiments.

Dr. Tyndall began by remarking that it had, for the last ten years, been his endeavour to make radiant heat a means of getting an insight into the working of the atomic forces, or, in other words, into the state which is called chemical combination. Whilst pursuing his experiments with luminous waves on matter in a finely divided state, he was forced to imagine molecules and atoms; indeed, his belief in the existence of atoms is founded more upon those physical evidences than upon the considerations which are current in the chemical world. If he had to give up the notion of atoms, and to replace that conception by the abstract idea of multiple proportions, he would feel completely at a less how to account for changes in the physical properties of matter. After these introductory remarks, the lecturer proceeded to the main subject. The apparatus which served to illustrate the statements consisted of a glass tube, about 3 feet in length and about 3 inches internal diameter, closed at each end by glass discs. This tube, after having been exhausted by an air-pump, was partly filled with dry air which had been permitted to bubble through the liquid whose vapours were to be examined. The condensed beam of an electric lamp was now caused to pass through the tube from end to end.

Since the aim of these experiments is to render visible the chemical action of light upon vapours, substances have been chosen, one, at least, of whose products of decomposition by light has so high a boiling point that, as soon as it is formed, it is precipitated. Nitrous oxide gas, the vapours of amylic iodide, amylic nitrate, benzol, &c., mixed with some air which had passed through hydric nitrate or hydric chloride, were found well suited for this purpose. In all cases, no matter what the nature of the vapour was, if only employed in a sufficiently attenuated state, the visible action commenced with the formation of a blue cloud, which, in some instances, was of the deepest azure tinge, rivalling the colour of the purest Italian sky. When a cell containing some of the liquid whose vapours were to be examined was inserted between the lamp and the tube, no clouds were formed within the tube—the luminous waves traversing the liquid had been deprived of their acting power. When polarised light was sent through the tube, the blue cloud was visible only in one direction, the direction varying according to the position of the Nicol prism. When the short diagonal of the Nicol was vertical, the blue cloud was seen when the spectator's eye looked horizontally upon the tube, not otherwise. As soon as the prism was turned round its axis, the blue cloud was only seen when the line of vision fell vertically upon the experimental tube.

After concluding this account of this highly interesting

subject, Professor Tyndall showed some of the experiments bearing on his researches upon Dust, quite recently communicated at the Royal Institution

The next meeting of the Society will take place on March 3rd, when Dr. Gladstone will deliver a lecture on "Indices of Refraction."

March 3rd, 1870.

Dr. A. W. WILLIAMSON, F.R.S., &c., *President, in the Chair.*

MR. C. P. SANDBERG, of Stockholm, was elected a Fellow of the Society.

The first paper was by DR. GLADSTONE, on "*Refraction Equivalents.*"

Three distinct lines of research had led up to the discovery of these equivalents. The first was the influence of temperature on the refraction of light by liquids; the second, the refraction of mixtures or combinations as compared with that of their constituents; and the third, the refractive indices of different members of homologous series of organic compounds. As to the first of these, it was found, by the joint labours of Dr. Gladstone and the Rev. Pelham Dale, that the refraction and the dispersion decrease as the temperature rises. Further examination showed a close relation between the change of density and the change of the refractive index minus unity, which the experimenters termed the "refractive energy," and which is expressed in the language as $u - 1$. This energy, divided by the density, that is,

$$\frac{u-1}{d}$$

is called the "specific refractive energy," and is, in the case of liquids, a constant, not affected by temperature. This conclusion was subsequently confirmed by the experiments of Landolt, Wüllner, and Kühlmann. As to the second line of research (that of the refraction of mixtures, solutions, and simple combinations), Duleng attempted to show in regard to gases, and Hock in regard to some liquids, that the refractive power of a mixture is the mean of the refractive powers of its constituents. But Gladstone and Dale arrived at the conclusion that here, also, the nearest approximation to the truth was given by

$$\frac{u-1}{d};$$

and their opinion has been fully confirmed by the careful experiments of Wüllner. This general expression holds good, also, in the case of a gas or a solid in solution; and, indeed, it was expected to be so, for water, phosphorus, and sulphur have the same energies in the liquid and solid states. The question now presented itself—Does an elementary substance retain its specific power of retarding rays when it is combined chemically with other elements? An affirmative reply was suggested by many considerations. It was, for instance, found that bromoform ($CHBr_3$) and bibromide of bromethylene ($C_2H_2Br_2$) have almost the same specific refractive energy as bromine itself.

On the other hand, however, the investigators observed that isomeric liquids were not always identical in refractive energy; and that the replacement of hydrogen by oxygen in organic compounds effected a much greater optical change in some instances than in others. Hence the conclusion was drawn that the specific refractive energy of every liquid is composed of the specific refractive energies of its component elements, modified by the manner of combination.

The third line of research was that of the refractions of different homologous compounds. The experiments of Delffs, of Landolt, and of Gladstone and Dale, have led to the view that, in all the series containing the radicles, methyl and its congeners, the specific refractive energies increase as the series advances, and that the amount of optical change is less between the higher than between the lower members of the series. Landolt, adopting Gladstone and Dale's formula for the specific refractive energy, multiplied it by the atomic weight P; and this

$$P\,\frac{u-1}{d}$$

he designated the "refraction-equivalent." According to this representation, the refraction-equivalent of a body is the sum of the refraction-equivalents of its constituent elements. The great advantage of this kind of expression is that it permits of the easy comparison of the optical properties of different substances. By making these comparisons, Landolt found that the refraction-equivalent of carbon is 5·0; that of hydrogen 1·3; and that of oxygen, 3·0. Direct experiments have given figures very close to these. The way of calculating the refraction-equivalent of a compound from these data may be illustrated by ether, $C_4H_{10}O = 4(5{\cdot}0) + 10(1{\cdot}3) + 3{\cdot}0 = 36{\cdot}0$. The refraction-equivalent deduced from observation is 36·26 A great variety of liquids have given, by calculation, the same figures for the refraction-equivalents as by direct investigation. Yet there are exceptions to this agreement with theory. The whole group of the aromatic hydrocarbons and their derivatives give refraction-equivalents much above the calculated numbers. This anomaly must be due to an erroneous representation of the constitution of their nucleus, which cannot be greater than C_6H_3. However, the above method makes it possible to find the refraction-equivalents of bodies which could not otherwise be taken—for instance, of metals. The refraction-equivalents of fifty elements have been determined in this way.

It is to be remarked that the figures in the following list, which gives the refraction-values of the more important elements, represent A of the solar spectrum:—

Aluminium...	8·4	Manganese...	12·2—26·2
Barium.....	15·8	Mercury.....	21·3—29·0
Bromine.....	15·3—16·9	Nitrogen....	4·1— 5·3
Calcium.....	10·4	Oxygen.....	2·9
Carbon.....	5·0	Phosphorus..	18·3
Chlorine.....	9·9—10·7	Platinum ...	26·0
Chromium...	15·9—23·0	Potassium...	8·1
Copper.....	11·6	Silicon.....	7·5— 6·8
Hydrogen....	1·3— 3·5	Silver.....	13·5
Iodine	24·5—27·2	Sodium.....	4·8
Iron.....	12·0—20·1	Sulphur.....	16·0
Lead.....	24·8	Tin.....	27·0—19·2
Magnesium...	7·0	Zinc.....	10·2

It will be seen that some of the elements have a double value; and this peculiarity is, in most cases, coincident with a change of atomicity. Thus iron, in the ferrous salts, has the equivalent 12·0; in the ferric salts 20·1 and, since the refraction-equivalent of iron in potassic ferricyanide is 11·7, the view suggests itself that the metal is here in the same condition as in the ferrous salts. Great anomalies present themselves in the case of oxygen. Its equivalent, in many compounds, is 2·9; but, in others, it comes down to 2·1; and, in some cases, as in some sulphates and phosphates, it would seem to be a negative quantity. This points to the conclusion that oxygen has the power of greatly modifying the action on light of those bodies with which it is combined in a high proportion.

On looking over the above list, one is struck by the identity of the equivalents of those elements which have the same, or nearly the same, atomic weight. This property is still more prominent when the specific refractive energies of the elements, instead of their refraction-equivalents, are considered. The following pairs may serve as illustration:—

Iron.....	0·214	Aluminium	0·307	Bromine	0·191
Manganese	0·222	Chromium	0·305	Iodine..	0·193

But the most suggestive comparison is that between the specific refractive energy and the combining proportions of

those metals that form salts not decomposable by water. By combining proportion is meant the actual amount which will combine with a certain quantity of a salt radicle. A few of these metals may be quoted:—

	Specific refractive energy.	Combining proportion.
Hydrogen	1300	1
Aluminium	307	9·1
Calcium	260	20
Iron	214	28
Sodium	209	23
Potassium	207	39·1
Copper	183	31·7
Silver	125	108
Lead	120	103·5
	&c.	

The regularity in the decrease of the numbers in the first column, and the corresponding increase in the second column, would suggest that the combining proportions of silver, lead, &c., ought to be halved, in order to bring those elements to about their right places in the list. There is, further, a remarkable coincidence between the power of a metallic element to refract the rays of light and its power to saturate the affinities of other bodies (of course, it must be borne in mind that a small combining proportion means a high saturating power).

Dr. Thudichum made a communication "*On Kryptophanic Acid,*" a normal ingredient of human urine.

The substance can be obtained in various ways from the primary material. One is to treat the urine with an excess of milk of lime to concentrate the mixture, filter it from the gypsum to acidify the filtrate, and evaporate it to syrupy consistency. This syrup, after having been filtered from the salt-cake, is treated with strong alcohol, which separates the lime-salt of the kryptophanic acid as a dark, flaky mass. The impure lime-salt is dissolved in water, and mixed with a solution of neutral lead-acetate: a dark-coloured precipitate is formed, from which the mother liquor is filtered. The filtrate, containing lead-kryptophanate, is treated with strong alcohol, whereupon white lead-kryptophanate is deposited in flakes, from which the acid is liberated by sulphuretted hydrogen.

Kryptophanic acid is an amorphous, gummy mass, transparent, and nearly colourless. It forms salts with the alkalies, the alkaline earths, and many metals. In the aqueous solutions of its earthy salts, a precipitate is produced by mercuric nitrate (the ordinary analysis for urea by this reagent is thus shown to be liable to error). The determinations of the free acid, as well as of its salts, have led to the formula $C_5H_3NO_4$, and shown the acid to be dibasic; in some cases, however, it may be taken as tetrabasic, and then its formula would be $C_{10}H_{12}N_2O_{10}$.

For the next meeting, on March 17th, the following papers are announced:—"On Artificial Alizarine," by W. H. Perkin, F.R.S.; and, "On the Combinations of Carbonic Acid with Ammonia and Water," by Dr. Divers.

March 17th, 1870.

Dr. A. W. Williamson, F.R.S., &c., *President, in the Chair.*

The following gentlemen were elected fellows:—D. Brown, A. Muirhead, T. L. Patterson, D. Penny, S. T. Smith

The first paper read was "*On Artificial Alizarine,*" by W. H. Perkin, F.R.S.

Alizarine was first obtained from madder in a crystalline state by Robiquet and Colin. Their method of preparation (viz., sublimation) rendered it, however, a matter of doubt whether alizarine existed as such in the madder, or was a product of decomposition of some other body. Dr. Schunk, having succeeded in obtaining alizarine-crystals without taking recourse to sublimation, proved the first view. He gave it the formula $C_{14}H_{10}O_4$; whilst Strecker believed it to be $C_{10}H_6O_3$, relating it to Laurent's chloroxynaphthalic acid, since both these substances yield phthalic acid on treatment with hydric nitrate; in fact, chloroxynaphthalic acid was regarded as chlorinated alizarine—

$$\underbrace{C_{10}H_6O_3}_{\text{Alizarine, or oxynaphthalic acid.}} \qquad \underbrace{C_{10}H_5ClO_3}_{\text{Chlorinated alizarine, or chloroxynaphthalic acid.}}$$

About five years since, Martius and Griess, when investigating the amido-derivatives of naphthol, obtained a colouring-matter possessing Strecker's formula; yet it was not alizarine, but a body isomeric with it. Some time after the discovery of this supposed isomer of alizarine, Graebe commenced his researches on quinone. This substance, obtained, as early as 1838, by Woskressensky as a product of the oxidation of quinic acid, was regarded by Kekulé as containing two molecules of carbonyl—$CO = C_4H_4 = CO$. But Graebe, induced by the results he had gained in his investigations of the quinone compounds, viewed it as a substitution-product of benzol, two of whose hydrogen-atoms are replaced by the group $[O-O]''$, in which half of the combining-values of oxygen saturate each other—

$$\underbrace{C_6H_6}_{\text{Benzol.}} \qquad \underbrace{C_6H_4(O_2)''.}_{\text{Quinone.}}$$

The best-known derivative of quinone is chloranil, or perchloroquinone, which is obtained by heating phenol with potassic chlorate and hydric chloride. When this body, $C_6Cl_4(O_2)''$, is heated with alkalies, potassic chloranilate, or dichloroquinonate, is formed. According to this reaction, Graebe regarded Laurent's chloride of chloroxynaphthyl as the dichloriuated quinone of naphthaline—

$$\underbrace{C_{10}H_8}_{\text{Naphthaline.}} \qquad \underbrace{C_{10}H_4Cl_2(O_2)''}_{\text{Chloride of chloroxynaphthyl, or dichlornaphthoquinone.}}$$

When this naphthaline derivative is heated with alkalies, it behaves like chloranil; but, whilst, in the latter compound, two atoms of chlorine are removed, only one chlorine-atom is displaced in the case of the naphthaline derivative—

$$\underbrace{C_{10}H_4Cl_2(O_2)''}_{\text{Dichlornaphthoquinone.}} + 2KOH = \underbrace{C_{10}H_4Cl\left\{\begin{matrix}(O_2)''\\KO\end{matrix}\right.}_{\text{Potassic chloroxynaphthalate.}} + KCl + H_2O.$$

$$C_{10}H_4Cl\left\{\begin{matrix}(O_2)''\\KO\end{matrix}\right. + HCl = \underbrace{C_{10}H_4Cl\left\{\begin{matrix}(O_2)''\\HO\end{matrix}\right.}_{\text{Chloroxynaphthalic acid.}} + KCl.$$

Chlorinated quinones of toluol were obtained by Graebe and Burgmann, by heating cresylic acid with potassic chlorate and hydric chloride—

$$\underbrace{C_6\left\{\begin{matrix}CH_3\\(O_2)''\\Cl_3\end{matrix}\right.}_{\text{Trichlortoluquinone.}} \qquad \underbrace{C_6\left\{\begin{matrix}CH_3\\(O_2)''\\Cl_2\\H\end{matrix}\right.}_{\text{Dichlorotoluquinone.}}$$

After it had been shown that chloroxynaphthalic acid was a quinone-acid, Graebe and Liebermann thought it probable that alizarine belonged to the quinone series. To gain some information about the hydrocarbon to which alizarine is related, they heated a specimen of the natural colouring-matter with powdered zinc, according to Baeyer's method of reducing aromatic compounds; and they obtained a substance of the composition $C_{14}H_{10}$. This hydrocarbon formed, with picric acid, a red compound, and, in fact, possessed all the properties of anthracene as obtained from coal-tar.

This discovery led Graebe and Liebermann to assume alizarine to be the quinone-acid of anthracene—

$$\underbrace{C_{14}H_{10}}_{\text{Aothracene.}} \qquad \underbrace{C_{14}H_8(O_2)''}_{\text{Anthraquinone.}} \qquad \underbrace{C_{14}H_6\left\{\begin{matrix}(O_2)''\\ HO\\ HO\end{matrix}\right.}_{\text{Anthraquinonic acid or alizarine.}}$$

Having obtained anthracene from alizarine, it now remained to produce alizarine from anthracene. Many years ago Laurente had obtained an oxygenated derivative of anthracene of the composition $C_{14}H_8O_2$. Graebe and Liebermann at once recognised this as the quinone of anthracene, and now it remained for them only to transform this anthraquinone into the acid by replacing two atoms of hydrogen by two of hydroxyl. For this purpose they heated anthraquinone with bromine, whereby dibrom-anthraquinone was obtained—

$$C_{14}H_8(O_2)'' + 4Br = C_{14}H_6\left\{\begin{matrix}(O_2)''\\ Br_2\end{matrix}\right. + 2BrH.$$

On treating this with potassic hydrate at a temperature of about 180° C., the potassium salt of alizarine was obtained, from which the alizarine was liberated by hydric chloride—

$$\underbrace{C_{14}H_6\left\{\begin{matrix}(O_2)''\\ Br_2\end{matrix}\right.}_{\text{Dibromanthraquinone.}} + 4KOH = \underbrace{C_{14}H_6\left\{\begin{matrix}(O_2)''\\ (KO)_2\end{matrix}\right.}_{\text{Potassic alizarate.}} + 2KBr + 2H_2O.$$

$$C_{14}H_6\left\{\begin{matrix}(O_2)''\\ (KO)_2\end{matrix}\right. + 2HCl = \underbrace{C_{14}H_6\left\{\begin{matrix}(O_2)''\\ (HO)_2\end{matrix}\right.}_{\text{Alizarine.}} + 2KCl.$$

By thus producing alizarine from anthracene, Graebe and Liebermann have given the first instance of the artificial formation of a vegetable colouring matter.

But to turn this beautiful discovery to practical account, to render alizarine from anthracene a substitute for madder, it was necessary to replace the bromine required in the process by some cheaper reagent. It is known that hydric sulphate forms with many organic bodies compounds called sulpho-acids. According to the experiments of Wurtz and of Kekulé these compounds are acid sulphites.

$$\underbrace{C_6H_6SO_3}_{\text{Sulpho-benzolic acid.}} = \underbrace{C_6H_5.HSO_3}_{\text{Phenyl-sulphurous acid.}}$$

$$\underbrace{C_{10}H_8(SO_3)_2}_{\text{Disulpho-naphthalic acid.}} = \underbrace{C_{10}H_6\left\{\begin{matrix}HSO_3\\ HSO_3\end{matrix}\right.}_{\text{Naphthaline disulphurous acid.}}$$

for, when heating sulpho-benzolic acid with potash they obtained a carbolate, and a sulphite—

$$C_6H_5.HSO_3 + 3KOH = C_6H_5KO + K_2SO_3 + 2H_2O.$$

Disulpho-naphthalic acid yields, by similar treatment, a naphthalenate and a sulphite—

$$C_{10}H_6\left\{\begin{matrix}HSO_3\\ HSO_3\end{matrix}\right\} + 6KOH =$$

$$= \underbrace{C_{10}H_6\left\{\begin{matrix}KO\\ KO\end{matrix}\right\}}_{\text{Potassic naphthalate.}} + 2K_2SO_3 + 4H_2O.$$

This potassic naphthalate can, by addition of an acid, be transformed into hydric naphthalate,

$$C_{10}H_6\left\{\begin{matrix}HO\\ HO\end{matrix}\right.$$

which body stands to naphthaline in the same relation as alizarine to anthraquinone.

It appeared therefore probable that if a disulpho-acid of anthraquinone could be found, the formation of alizarine by a similar process may be rendered possible.

The formation of this sulpho-acid seemed, at first, not very probable, on account of the remarkable stability of anthraquinone, but on strongly heating it with hydric sulphate a sulpho-acid was at last obtained, which, on analysis, was found to be the desired disulphoanthraquinonic acid—

$$C_{14}H_6\left\{\begin{matrix}(O_2)''\\ HSO_3\\ HSO_3\end{matrix}\right.$$

This compound, heated with potassic hydrate to about 180° yields sulphite and alizarate of potash—

$$C_{14}H_6\left\{\begin{matrix}(O_2)''\\ HSO_3\\ HSO_3\end{matrix}\right\} + 6KHO =$$

$$= \underbrace{C_{14}H_6\left\{\begin{matrix}(O_2)''\\ KO\\ KO\end{matrix}\right\}}_{\text{Potassic alizarate.}} + 2K_2SO_3 + 4H_2O.$$

from which potash salt the alizarine is thrown down by acids, just as brightly coloured and as pure as the alizarine from dibromanthraquinone.

It is, however, to be remarked that alizarine is not the primary product of the reaction of potash on the sulpho-acid, an intermediate body being first produced, which may be called sulphoxanthraquinonic acid, and the formation of which may be thus expressed:—

$$C_{14}H_6\left\{\begin{matrix}(O_2)''\\ HSO_3\\ HSO_3\end{matrix}\right\} + 4KOH =$$

$$= \underbrace{C_{14}H_6\left\{\begin{matrix}(O_2)''\\ KO\\ HSO_3\end{matrix}\right\}}_{\text{Potassic sulphoxanthraquinonic acid.}} + K_2SO_3 + 3H_2O.$$

This intermediate body is crystalline, of a yellow or orange colour, easily soluble in water, produces, with caustic alkalies, violet or blue solutions, and when heated with potassic hydrate yields alizarine and sulphurous acid.

The process just described may be modified by first forming a disulpho-acid of anthracene, and then converting this by means of oxidising agents into the disulphoanthraquinonic acid.

In the conversion of disulphoanthraquinonic acid into alizarine by the action of potassic hydrate, a peculiar reverse action takes place to some extent, both anthraquinone and anthracene being formed.

Artificial alizarines entirely identical with the colouring matter obtained from the madder root. Both of the products crystallise in needles, which are usually curved, especially when small. They dissolve in caustic alkalies, forming violet solutions of the same tint. When applied to mordanted fabrics they produce exactly the same colours, bearing the treatment with soap equally. They also possess precisely the same tinctorial value. The colours produced on fabrics by the artificial alizarine are as fast against light as those of madder. Cupric acetate produces in their alcoholic solutions a purple colouration. Their alkaline solutions show identical absorption bands in the spectrum. Both yield phthalic acid when treated with hydric nitrate.

It may be observed that a solution of sulphoxanthraquinonic acid in alcoholic potash has a very similar spectrum as an analogous alizarinic solution; but the spectra of the respective aqueous solutions are quite different.

As a substitute for madder artificial alizarine has been objected to, on the ground that pure alizarine alone will not produce the madder colours, other colouring matters being required. But Schunck says that, after a long course of experiments, he has been led to the conclusion, that the

final result of dyeing with madder is simply the combination of alizarine with the various mordants employed, and he recommends extraction from madder prints as the easiest method of preparing pure alizarine on a small scale. Mr. Perkin, on experimenting in this direction, could find nothing but alizarine on finished madder print. There is a second colouring matter in the madder root, the purpurine, but this cannot be found in the colour of the prints; if a mere trace of it were present it could easily be detected by its characteristic spectrum. It cannot be affirmed that purpurine never exists on prints dyed with madder or garancin, but it is certain that the higher the class of print, and, consequently, the more brilliant the colours, the purer is the alizarine in combination with the mordants.

Artificial alizarine as sent to the dyer and printer is not exactly pure alizarine, and generally produces, with alumina mordants, a somewhat redder shade than madder. This is due to some impurities, whose nature is as yet, not known. Schunck has, however, already succeeded in obtaining a yellow crystalline body from the residues; but this yellow substance does not appear to have any affinity for mordants, and therefore cannot be injurious.

A good deal has been said about the supply of anthracene. It must be remembered, however, that tar distillers have had as yet but little experience in separating this substance. Mr. Perkin's investigations on this matter have led him to believe that coal-tar contains considerable quantities of this hydrocarbon. No doubt the kind of coal used as well as the temperature employed in the gas works, influences the quality of the tar as a source of anthracene, but upon these points no definite information has yet been obtained.

Mr. Perkin illustrated his highly interesting lecture by exhibiting samples of fabrics dyed and printed with artificial alizarine, and also by projecting the spectra of some alizarine solutions on a screen.

The following paper was "*On the Combinations of Carbonic Acid with Ammonia and Water*," by Dr. Divers, the reading of which, however, was, on account of the advanced hour, postponed for the next meeting, when, besides this, the following papers will be read: "Deep Sea Water," by John Hunter, and "Refraction Equivalents of Aromatic Hydrocarbons," by Dr. Gladstone.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, February 8, 1870.

J. P. Joule, LL.D., F.R.S., *President, in the Chair.*

Mr. Spence repeated the experiment he had made at the Exeter meeting of the British Association, showing that the temperature of saturated saline solutions could be raised to their boiling points by merely passing through them ordinary steam at a temperature of 212°. Thus a solution of chloride of sodium was raised to a temperature of 221°, and one of chloride of calcium to 248°. Chloride of sodium would have risen to 224·3° and chloride of calcium to 286° had the experiment been continued, but the point was sufficiently demonstrated that by steam of 212° much higher temperatures can be obtained.

Ordinary Meeting, February 22, 1870.

J. P. Joule, D.C.L., LL.D., F.R.S., &c., *President in the Chair.*

The President referred to the observations he had made in former years on the progressive rise of the freezing point of one of his thermometers, published in the Proceedings for April 16, 1867. He had made a further observation on the 12th February inst., and found that a rise, which though very small was unmistakable, was still taking place after a lapse of time of 26 years since the bulb was blown. The results are as follow in indications of the thermometer, calling the first observation in April, 1844, zero. 12·9 divisions of the thermometer correspond to one degree Fahrenheit.

April,	1844	0
Feb.,	1846	5·5
Jan.,	1848	6·6
Feb.,	1853	8·8
April,	1856	9·5
Dec.,	1860	11·1
March,	1867	11·8
Jan.,	1868	11·92
Feb.,	1870	12·02

Dr. F. Crace Calvert, F.R.S., stated that he did not intend to read a paper on *artificial alizarine*, some of the facts he was going to bring before the notice of the meeting being well known to his colleagues, the chemists of this district, but he hoped it might be interesting to the general members of the Society to have an idea of the progress that had been made during the last few months in the production of this substance. They were aware that alizarine was the essential colour-giving principle of the madder root. Every cultivated mind in Lancashire ought to be acquainted with each step made in the artificial production of this dye, owing to the immense capital involved in the cultivation of the madder plant in the working of it up in this country, as well as the revolution it will effect in our commercial relations and the important new branches of manufacture it will create.

It was well known to the members of this Society that about 12 months ago Messrs. Graebe and Liebermann had discovered a method of producing alizarine from a coal-tar product, which up to that time had attracted very little attention, even in the scientific world, viz., anthracene, $C_{14}H_{10}$, and that by oxidation they transformed it into anthraquinone, $C_{14}H_8O_2$, which in turn was changed into bibromanthraquinone, $C_{14}H_6B_2O_2$, this being converted into alizarine, $C_{14}H_8O_4$, by the addition of two equivalents of oxygen and the formation of two equivalents of hydrobromic acid.

It was felt by all chemists that this discovery was one of great importance, though it was too complicated to be commercially useful, but the Gordian knot being now cut, the commercial production of artificial alizarine was merely a question of time, and what he would now relate showed the marked progress which had been made toward this end.

There were already three patents published; and one process, the details of which are kept secret, is being worked by Messrs. Meister, Lucius, and Co., of Hœchst, near Frankfort. The patents are those of Messrs. Brænnan and of Gutzkow, of Messrs. Caro, Graebe, and Liebermann, and Mr. W. H. Perkin. It was curious to notice that the patent of Messrs. Caro was dated the 25th of June last, and Mr. Perkin's the 26th of the same month; and that all these patents effect the same purpose by simply employing different oxidising agents. Messrs. Brænnan and Gutzkow oxidise the anthracene into anthraquinone by means of the nitrate of protoxide of mercury, Messrs. Caro by peroxide of manganese, and Mr. Perkin employs oxanthracene, and then all by further processes, which are nearly the same, convert anthraquinone into alizarine.

As it might be interesting to many of the members to have an outline of one of the methods employed, he would therefore describe a process detailed in the specification of Messrs. Caro, Graebe, and Liebermann. One part of anthracene is heated with four of sulphuric acid, of specific gravity 1·845, for three or four hours, to a temperature of 212° F., and then for about an hour at 300°. The mixture is allowed to cool, and to it is added water equal to three times the weight of the anthracene employed, and manganese equal to four times that weight.

The whole is boiled for three hours and milk of lime added, which gives rise to a deposit consisting of the excess of lime and manganese used and protoxide of manganese,

while there remains in solution a double sulphate of anthraquinone and lime. This solution is now acted on by carbonate of soda in slight excess, carbonate of lime separates, and the salt of soda thus produced is evaporated to dryness. This solid mass is then mixed with two or three parts of caustic potash or soda and a small quantity of water, and the whole heated under pressure in suitable vessels at a temperature of 350° to 500° F. for one hour, when the anthraquinone is further oxidised, and converted into alizarine. The alkaline mass, on cooling, is dissolved in water, and sulphuric or acetic acid added in slight excess, when an orange-yellow, flocculent substance precipitates, which, when properly washed and dried, is artificial alizarine.

If this process can be carried out on a practical scale (and there is no doubt that it will be, under the direction of such clever chemists as Messrs. Perkin, Caro, and others), we may then fairly consider the production of artificial alizarine as having reached the sphere of commercial application; though I may add, from personal experience, that some time must elapse before it can be manufactured in quantities sufficient to affect the present applications of madder, garancine, Schunck's commercial alizarine, &c.

There is another great difficulty yet to be overcome before the artificial alizarine can become a commercial article, that is, the obtaining of anthracene in larger quantities, and this question is of some importance to us, England being the great tar producing country. Anthracene does not appear to exist in greater proportion than one in a thousand of tar, and is only liberated or produced during the latter part of the distillation of the tar. In fact, if the distillation be stopped so as to leave a very soft pitch, the oils obtained give little or no anthracene. If, on the other hand, it is carried on so as to get 10 or 15 per cent more oil off, there remains a hard pitch which has little or no value at the present day, the quantity of anthracene obtained varying very much according to the nature of the coals employed in the production of the tar, ranging from 1½ to 8 per cent of the heaviest oils separated; it will scarcely be worth the while of the tar distiller to depreciate the value of one of the staple articles of his trade to produce it, and even when the heavy oil is obtained the separation of the small quantity of anthracene it contains, and its purification for use according to the above patents, will yet require much time and research. It is well known to all who have worked on the coal-tar products that each well-defined compound is mixed with homologues which renders its separation and purification a work of extreme difficulty; thus analine is mixed with picoline and several other alkaloids, benzol with toluol and other hydrocarbons, carbolic acid with cresylic and other acids, and anthracene is also mixed in a similar manner with homologous compounds.

The mere distillation and filtration of the solids obtained and their hot or cold pressing, or even their sublimation, do not effect the complete purification of the substance. The purest product I have been able to obtain on a moderate commercial scale has contained, when cold pressed about 40 per cent, and when hot pressed about 70 per cent of anthracene. One of the chief difficulties in its preparation is the fact of its great solubility in its liquid homologues at a moderate temperature, thus an oil, at 40° or 45° F., will yield a comparatively large quantity of anthracene by filtration, but if its temperature be raised to 70° or 80°, the anthracene will be completely dissolved.

I am aware that it has been proposed to distil soft pitch so as to obtain the volatile products that are given off in coaking it, but the expense, difficulty, and danger of such an operation are such that I doubt if they can be overcome so as to produce anthracene of comparative purity on a commercial scale.

Papers have been published respecting the identity of the alizarine produced by the process of Messrs. Meister, Lucius, and Co., with natural alizarine, by Dr. Schunck, Professor Bolley, and Messieurs Emile Kopp, Camille Kœchlin, La Fraisse, G. Wallace Young, and J. Christie. The opinions of these chemists vary. Dr. Schunck and Professor Bolley consider it identical, the other gentlemen considering it not identical, some of them maintaining it to be a mixture of purpurine and alizarine.

The product made according to the patents mentioned I have not had an opportunity of examining, nor have I seen any papers on the subject in any of the scientific journals which have reached my hands; but as doubtless it will shortly be before the public, I shall take an early opportunity of laying before the society the results of my own experience as well as those of others.

In conclusion, I think many years must elapse before artificial alizarine can replace madder and its preparations in all their varied applications in calico printing, but ere long the purity of the substance, artificially obtained, may prove of great service to the calico printer, by enabling him to produce, at a cheaper rate than now, certain styles of prints as well as new styles and effects.

Specimens of anthracene, artificial alizarine, and dye fabrics were exhibited.

Dr. Schunck, F.R.S., remarked that the practical success of the new process would in a great measure depend on the price of the raw material, anthracene, and on the amount of colouring matter to be obtained from it. The process itself was, however, as far as the few experiments he had made allowed him to judge, a very simple and easy one, requiring the use of no costly materials. He was convinced himself that the artificial product was identical with the natural alizarine of madder, the only difference being that the former was generally contaminated with some impurity which prevented its crystallising easily. Purpurine was not formed along with alizarine, as had been supposed. He also exhibited to the meeting some specimens of Turkey-red dyed with artificial alizarine, which had been sent to him by Mr. Perkin, and stated that the latter had already manufactured several tons of the new product.

In connection with this subject Dr. Schunck referred to a notice contained in the Chemical News (vol. xxi., p. 81; *Am. Repr., April, '70, page* 207), giving an account of a process for preparing pure alizarine from Turkey-red dyed cotton. The author, M. Schützenberger, does not state that the process is new, though he seems to claim it as his own. Almost the same process was, however, described many years ago by Dr. Schunck, who claims, indeed, to have been the first to point out that Turkey-red, madder pink, and all the finer madder colors are simply compounds of alizarine and fatty acids with bases. The experiments on which this conclusion was founded were described in the edition of "Ure's Dictionary of Arts," published in 1859, under the heads of "Madder" and "Turkey-red," but the experiments themselves were made at a much earlier date.

"*On the Organic Matter of Human Breath in Health and Disease*," by Dr. Arthur Ransome, M.A.

The vapour of the breath was condensed in a large glass flask surrounded by ice and salt, by which a temperature several degrees below zero was obtained. The fluid collected was then analysed for free ammonia, urea and kindred substances; and for organic ammonia—the method employed being that invented by Messrs. Wanklyn and Chapman for water analysis.

The breath of eleven healthy persons and of 17 affected by different disorders was thus examined, and the results were given in two tables.

The persons examined were of different sexes and ages, and the time of the day at which the breath was condensed varied.

In both health and disease the free ammonia varied considerably, and the variation could not be connected with the time of the day, the fasting or full condition. Urea was sought for in fifteen instances—three healthy persons and twelve cases of disease—but it was only found in two cases of kidney disease, in one case of diphtheria, and a faint indication of its presence occurred in a female suffering from catarrh.

The quantity of ammonia, arising from the destruction of organic matter, also varied, possibly from the oxidation of albuminous particles by the process of respiration; but in healthy persons there was a remarkable uniformity in the total quantity of ammonia obtained by the process. Amongst adults the maximum quantity per 100 minims of fluid was 0·45 of a milligramme, and the minimum was 0·35.

A rough calculation was given of the total quantity of organic matter passing from the lungs in twenty-four hours—in adults about 3 grs. in 10 ozs. of aqueous vapour, a quantity small in itself, but sufficient to make this fluid highly decomposable, and ready to foster the growth of the germs of disease.

In disease there was much greater variation in the amount and kind of organic matter given off.

In three cases of catarrh, one of measles, and one of diphtheria, the total ammonia obtained was much less than in health—less than 0·2 of a milligramme—a result probably due to the abundance of mucus in those complaints, by which the fine solid particles of the breath were entangled.

In two cases of whooping cough it was also deficient, but as they were both children, the lack of organic matter may have been due to their age.

In cases of consumption, also, the total ammonia was less than in health; but in one case of this disease associated with Bright's disease a large amount of organic matter was given off, a portion of it due to urea.

In kidney diseases the largest amount of organic matter of all kinds was found in the breath. The ammonia in one case of Bright's disease was 1·8 milligrammes in 100 minims of fluid, and urea was largely present. Perhaps this fact might be taken as an indication of the need of measures directed to increase the activity of other excretory organs.

In one case of ozona or offensive breath the total quantity of ammonia obtained was greater than in any healthy subject, but the excess was chiefly due to organic matter.

One convalescent case of fever was examined, and the total ammonia was found to be deficient.

The air of a crowded railway carriage, after fifteen minutes occupation, was also tested by this method, and in about 2 cubic feet 0·3 milligrammes of ammonia and 3 milligrammes of organic matter were found.

With reference to the presence of organic matter in the atmosphere, it was pointed out that the subject was in no way a novel one, and that it had, during the last thirty years, been very fully investigated by many observers, more especially by Schwann, Dusch, Schroeder, Helmholtz, Van den Broeck, Pasteur and Pouchet, but it was shown that it is to Dr. Angus Smith that we owe the discovery of the readiness with which living organisms are formed in the condensed breath of crowded meetings, and the determination of the actual quantity of organic matter in the air of different localities.

Mr. Dancer's calculation of the number of spores contained in the air was noticed, but a source of error was pointed out in the readiness with which organisms are developed in suitable fluids, even in the course of a few hours. Observations upon the organic particles of respired air had at different times been made by the author.

1. In 1857, glass plates covered with glycerine had been exposed in different places and examined microscopically. Amongst others, in the dome of the Borough Gaol, to which all the respired air in the building is conducted, organised particles from the lungs and various fibres were found in this air.

2. During a crowded meeting at the Free Trade Hall air from one of the boxes was drawn for two hours through distilled water, and the sediment examined after thirty-six hours. The following objects were noted:—Fibres, separate cellules, nucleated cells surrounded by granular matter, numerous epithelial scales from the lungs and skin.

3. The dust from the top of one of the pillars was also examined, and in addition to other objects, the same epithelial scales were detected.

4. Several of the specimens of fluid from the lungs were also searched with the microscope. In all of them epithelium in different stages of deterioration was abundantly present, but very few spores were found in any fresh specimen. On the other hand, after the fluid had been kept for a few hours, myriads of vibriones and many spores were found.

In a case of diphtheria, confervoid filaments were noticed, and in two other cases, one of measles and one of whooping cough, abundant specimens of a small-celled torula were found, and these were seen to increase in numbers for two days, after which they ceased to develop.

These differences in the nature of the bodies met with probably show some difference in the nature of the fluid given off; but it was pointed out that they afford no proof as yet of the germ theory of disease. They simply show the readiness with which aqueous vapour of the breath supports fermentation, and the dangers of bad ventilation, especially in hospitals.

Dr. E. Lund and Dr. H. Browne stated that they had also made experiments, the results of which were, in general, confirmatory of those obtained by Dr. Ransome.

GLASGOW PHILOSOPHICAL SOCIETY.

(Chemical Section.)

Ordinary Meeting, February 14, 1870.

Mr. E. C. C. Stanford, F.C.S., *in the Chair.*

The first paper was on "*Some Notes on Californian Borax,*" by Mr. Archibald Campbell, St. Rollox Chemical Works. The author referred briefly to the borax as obtained from Thibet under the name of tincal; and that of the Lagoons of Tuscany, and then he spoke of the boracic compounds obtained within the last few years in Peru. In the latter case, the deposit consists chiefly of borate of lime, with varying quantities of borate of soda. Having spoken at some length on the Peruvian deposits and of the opinions expressed by Mr. Walker (Chemical News, vol. xviii., p. 203; *Am. Repr., Dec.* '68, *page* 322), regarding their origin, Mr. Campbell stated that borax had lately been found at Halberstadt in Transylvania, in Ceylon, in several mineral springs in Canada East, and in the waters of the sea along the coast of California. The most important discovery of borax in recent years is that of the Borax Lake of California, a description of which was given by Mr. Campbell. It is about 40 miles from the Pacific, and 60 miles from Suisum Bay. Between it and Clear Lake (a lake about 25 miles long) there is a large accumulation of volcanic materials, containing much obsidian and pumice-stone, lying loosely heaped together in a ridge which separates the two lakes; in fact, all through the mountain ranges on the coast in the region under notice, there are hot springs and the remains of solfatara action. These strongly indicate a cross fracture through which the volcanic agencies have made themselves perceptible, and which probably forms a connection on the south-west with the geysers, thus forming a line of volcanic action nearly, if not quite, across the mountain chain. It is in this peculiarly volcanic action that the Borax Lake is situated. The lake is of variable size, according to the season of the year and the comparative dryness of the season. In September, 1863, the water occupied an area of about 4000 feet long, and 1800 feet wide in the widest part. Its length has been twice as great as it is at present, as is evident from the nature of the ground. In some very dry seasons, the lake is rendered entirely dry: in September, 1863, however, the water was about 3 feet deep. The existence of the lake was first made known to the world by Dr. Veatch, who examined it in September, 1856, and detected borax in its waters. It was not until some months afterwards that the existence of a large bed of borax crystals was discovered in the bottom of the lake. The land in the district belongs to the Californian Borax Company.

The water collected from the lake in 1863, on being analysed, was shown to contain 2401·56 grains of solid matter per gallon, of which about one-half was common salt, one-fourth

carbonate of soda, and the remainder chiefly borate of soda—there being 281·48 grains of the anhydrous borate, equal to 535·08 of crystallised borax to the gallon, or, in other words, 13 gallons of the water are equal to 1 lb. of the borax crystals. Traces of iodides and bromides were also found. A sample of water taken from a coffer-dam sunk in the middle of the lake was more concentrated. There were 3573·46 grains of solid matter per gallon; but the same ingredients were found, and in nearly the same proportions as in the water of the lake itself. The crystals vary in size, from those which are microscopic to such as are 2 or 3 inches across. They are mixed with bluish mud, and sometimes there are several alternating layers of mud and crystals of borax. I is believed that there are several thousand tons at the bottom of the lake. The crude borax is obtained so pure that it is used by the San Francisco assayers in preference to the refined borax imported from abroad. In the neighbourhood of the lake, there is a hot spring of a remarkable character, and said to yield about 300 gallons per minute. Mr. Campbell gave the following analysis of the water of the spring, the figures representing grains per gallon:—

Chloride of potassium	trace
" " sodium	84·62
Iodide of magnesium	0·09
Bromide of magnesium	trace
Bicarbonate of soda	76·96
" " ammonia	107·76
Biborate of soda	103·29
Sulphate of lime	trace
Alumina	1·26
Carbonic acid (free)	36·37
Silicic acid	8·23
Matter volatile at a red heat	65·77
	484·35

These figures necessarily represent anhydrous salts and, therefore, the 103·29 grains of biborate of soda represent 195·35 grains of crystallised borax.

The author had not ascertained the temperature of the spring, but it could not be high, owing to the great amount of bicarbonates, and from carbonic acid present in solution. He considered the most extraordinary feature of the analysis to be the very large quantity of ammoniacal salt present—exceeding, he believed, that of any spring yet analysed.

Mr. Campbell afterwards read a short paper on "*Notes on Sicilian Sulphur.*" He gave an account of the mode in which sulphur is distributed in nature, and of the various theories held regarding the formation of sulphur deposits. Some peculiar properties of sulphur were next spoken of; and the author concluded by mentioning some details regarding the means adopted for the extraction of the sulphur from the mineral masses in which it occurs in Sicily.

The author exhibited several specimens of Californian borax and Sicilian sulphur. A short discussion followed, the remarks being especially directed to the peculiarities of the analysis given above and the probable source of the nitrogen of the ammonia.

The next communication was entitled "*On the Composition of Ooze or Chalk Mud from the Atlantic Sea Bed,*" by Mr. James Mahony.

The author spoke of the interest that has been felt regarding the nature of the Atlantic sea bottom, and the conditions of life there present, ever since the first surveys were made in connection with the Atlantic telegraph cable. Previous to that time Professor Edward Forbes had expressed the opinion that organised beings could not live at greater depths than 200 fathoms; but Dr. Wallich had shown that animal life did exist even at a depth of 1260 fathoms, and that it was represented by various species of starfish and *Globigerina;* and, further, that the comparatively level plateau extending from Ireland to America was covered by a fine white mud, to which the name of "ooze" had been given. Mr. Mahony then referred to the deep-sea dredging expeditions of H.M.S. *Porcupine,* and stated that he had been favoured with a sample of the ooze lately sent to a scientific friend in Glasgow, by Professor Wyville Thomson. It was obtained from the deepest dredging, 2435 fathoms, about 150 miles west of Ushant, the temperature of the sea bottom being 36·5°. Part of the sample was air-dried and a small portion was put, when fresh, into methylated spirit. Mr. Mahony had examined the ooze both as a chemist and as a naturalist. The following is the analysis:—

Silica	26·60
Peroxide of iron and phosphates	3·80
Protoxide of iron	0·08
Carbonate of lime	58·80
Carbonate of magnesia	1·76
Sulphate of lime	trace
Soluble salts	4·20
Organic matter	2·30
Water	2·50
	100·04

The silica was found under the microscope to consist chiefly of minute structureless fragments, some of them being crystalline. A small number of diatoms were also found. The calcic carbonate consisted of larger organisms (class *Foraminifera*), some still containing the small particle of jelly-like matter constituting the animal substance of these organisms, and called *sarcode* by Dujardin. These doubtless yielded the organic matter noted in the analysis. The soluble salts were accounted for by the evaporation of the sea water with which the mud was charged when taken up.

Mr. Mahony then considered the question—"Does the presence of the gelatinous contents of the foraminifers indicate that they live and die on the sea bottom?" So far as the aëration of the water was concerned, he found no difficulty, especially when looking at the subject in the light thrown upon it by Mr. John Hunter's recent paper "On Analysis of Sea-Water Performed on Board the *Porcupine.*" (*Journal of the Chemical Society* for January, 1870.) He concluded his paper by stating that over the North-Atlantic sea-bed the chalk formation is in continued progress, the identity of the ooze with chalk, both chemically and organically, being very apparent. The siliceous grains have their counterpart in the layers of flint seen in the chalk cliffs,—probably formed by the aggregation of minute particles round a central nucleus,—while the species of minute shells found in the ooze are in many cases identical with those entombed long ages ago.

A short discussion followed, and then Mr. Stanford vacated the chair to read two short papers. The first was entitled "*Note on a Specimen of Shell Sand from the Island of Coll.*" The specimen examined had the following analysis:—

Carbonate of lime	68·50
Carbonate of magnesia	1·51
Silica sand	25·69
Phosphates, iron, and alumina	2·00
Organic matter	2·30
	10.000

It was very much agglutinated, owing to the carbonate of lime which the rain-water had taken up and afterwards deposited over the exposed grains of sand. The author mentioned that most of the islands of the Outer Hebrides have similar deposits of sand on their west coast, the east being covered with peat. The sand is generally composed almost entirely of the *débris* of shells of countless generations of molluscs. In the silica sand mentioned in the analysis there was felspar, and therefore potash. A trace of nitrogen was present in the organic matter. The specimen was much weathered, and, therefore, did not contain as much nitrogen as there would doubtless have been in the fresh state.

[English Edition, Vol. XXI., No. 535, pages 91, 92.]

Where the sand does not "blow" it bears a luxuriant crop of white clover, which is specially remarkable in North and South Uist. The presence of magnesia shows it to be a good food for clover. By mixing the shell sand with the peat an excellent soil is produced. With lime it forms a remarkably strong mortar, almost equal to a cement.

Mr. Stanford's next paper was a "*Note on Iodide of Cyanogen*," the result of the examination of a specimen of that compound which he had recently found while resubliming a lot of inferior iodine purchased in London. Although the impurity was said to be a common one, he had never met with it in any quantity before. Mr. Stanford detailed its properties and its reactions.

QUEKETT MICROSCOPICAL CLUB.

The annual *conversazione* of this club took place at University College on Friday evening, and was attended by a very numerous assembly of members and visitors.

The objects exhibited under the microscopes comprised specimens from nearly every branch of microscopical science, and evinced by their novelty an evident desire on the part of the members to cultivate every source likely to yield instruction. Amidst so much to attract attention it is impossible to make a selection; we may, therefore, merely remark that amateurs and professionals were equally assiduous in contributing to the general entertainment of the company. In addition to the objects exhibited, an interesting collection of photographs lent by the India Office, the Autotype Company, Mr. Frank, Mr. Good, and Mr. A. L. Henderson were much admired.

The whole process of micro-photography was demonstrated at frequent intervals by the Messrs. Solomon, the actinic influence being derived from their new magnesium lamp. Mr. Apps exhibited some large Gassiot's cascades and Geissler's tubes illuminated by his celebrated induction coil, and Mr. James How displayed Dr. Maddox's micro-photographs and some views of Swiss scenery, &c., by the aid of the oxy-hydrogen light. The meeting may be described as eminently successful.

NOTICES OF BOOKS.

Reports on the Progress of Practical and Scientific Medicine in different parts of the World. (For the year beginning June 1st, 1868, and ending June 1st, 1869.) Edited by Horace Dobell, M.D., &c., assisted by numerous and distinguished coadjutors. London: Longmans, Green & Co., 1870. Pp. 645.

In the preface to this work, the editor asks his readers "to accept this first year's report as a fragmentary hostage of the next; it was only last December that I designed this work, and since that time I have had to open up correspondence with all parts of the world. The design of this work is to bring together in the English language, original and independent reports from all parts of the world, written by distinguished men resident in the countries they represent." As regards the contents of the work it is a genuine *varietas delectat*. The book opens with a comparative table of weights, measures, &c., and also a table of comparison of the Fahrenheit with the Centigrade and Réaumur's thermometer; the arrangement is alphabetical, and therefore Africa takes precedence. Under this heading we meet with a very valuable record of meteorological observations on the West Coast of Africa, by Dr. J. A. B. Horton, arranged in the following manner:—Atmosphere; Exemption from what Diseases; Predisposed to what Diseases. America, as might be expected, is very well represented, and we learn from the work that this report is the production of a new society just set on foot at New York, for reporting the progress of medicine; and, owing to the embryonic condition of this society, it is not so complete as future reports will be. It is quite impossible to give in a few lines an adequate idea of the large amount of valuable and interesting matter contained in this volume. As an instance of the great variety of matter, we have an excellent paper on "Cider Colic," by J. Buckman; "On the Treatment of Pulmonary Consumption by Ether and Etherised Cod-liver Oil," Dr. B. W. Foster; there are also reports from several European countries, including remote Iceland; but we do not find reports from Russia, Spain, the Netherlands. From the colonies of the latter country there is a report by Dr. Wylie. Taking matters *en resumé*, we have to congratulate the editor on his first production.

A Dictionary of Scientific Terms. By P. Austin Nuttall, LL.D., Editor of "The Classical and Archæological Dictionary," "Standard Pronouncing Dictionary," and numerous educational works. London: Strahan & Co, 1869. 8vo.; pp. 325.

The object of this work is "to render the language of science intelligible not only to the professional student but to the general reader." It has been specially arranged with a view to educational purposes, and to further the working of the revised code which was framed a short time ago by the Committee of the Council for Education. Dr. Nuttall's book is dedicated "By special permission to the Right Honourable Robert Lowe, Chancellor of Her Majesty's Exchequer, and the eloquent representative of University *College* (*sic?*), London." Now, the Right Honourable Robert Lowe is not only Chancellor of Her Majesty's Exchequer, but Master of Her Majesty's Mint, and in these combined capacities he is at this moment preparing a Bill to consolidate and amend the laws relating to the coinage and the Mint. With such a subject, what can be more natural than that he should turn for some piece of technical or scientific information to the work so recently, and "by special permission" dedicated to him, and of which it may be reasonable to suppose he possesses an elaborately bound and large-paper copy? He seeks for—what shall we say?—*metals*, as most *apropos* to his new position, and at page 17 of the introduction, he reads, "A few of the principal metals are here given in alphabetical order:—

Antimony.	Copper.	Manganese.	Silver.
Arsenic.	Gold.	Mercury.	Steel.
Bismuth.	Iridium.	Nickel.	Tin.
Black-lead.	Iron.	Ochre.	Tungsten.
Brass.	Lead.	Pewter.	Zinc."
Cobalt.	Magnet.	Platinum.	

"I had no idea," muses the Right Honourable gentleman, "that black-lead and ochre were reckoned among the principal metals, but science is making wonderful strides now-a-days." Next he specialises, and turns to gold, silver, copper. Gold is found to be "the most valuable and ductile of all the metals, and is used by all civilised nations as a standard of value;" it "unites with most other metals, and with sulphur, ammonia, &c." "Silver is one of the fifty-five simple or elementary bodies, and included in the sub-division termed metals nearly white." "The ores of copper are very numerous, the principal being sulphuret of copper and iron (iron pyrites), and sulphuret of copper (nitrous copper ore)." Let us sincerely hope (and, if necessary, memorialise the Right Honourable gentlemen on the subject) that Mr. Lowe will not ordain this the text-book of the Treasury, will not have it employed by candidates for Civil Service appointments, will not get up his chemistry and metallurgy and general science from it. Now, if a new or modified code of taxes were framed on its authority, we do not know what would become of us, had we not Dr. Playfair in the House to see fair play in regard to all that relates to *scientia immutabilis*.

Now we fully recognise and admit the difficulty and labour of compiling such a work as that before us. We wish to make every allowance for this difficulty, and we assure

Dr. Nuttall we would always rather praise than blame If his soul be in law or literature, while his body, for the time being, is in science (like the man in the old Spanish song whose body was in Segovia while his soul was in Madrid), we have the more sympathy for him. He has told us in the preface that "occasional omissions or oversights may possibly be discovered," and he has asked "every indulgence from a generous public." We will respect this; it may be thought we have been seeking omissions and errors; now on our word of honour we will open the book several times at random, with our eyes shut, and thereupon criticise without favour and with our eyes open. "Crater, the mouth of a volcano. In *astrology*, a constellation in the southern hemisphere. Cretinism a species of *idiotism* with which the goitrous inhabitants of the alpine valleys are afflicted." "Fluoric Acid = 3 atoms of fluorine + 1 of boron. equiv. 66·98." (The last example p. 154, left-hand column.) "Chloride of Potash. a valuable compound prepared by passing chlorine gas into a mixture of 1 lb. of caustic lime, and 1 lb. of potash, with 8 lbs. of water." O! Dr. Nuttall, hard worker and earnest though you may be, we must tell you that this is not the science of to-day. We do not quote Werner for geology, Hoblyn for chemistry, Howard for meteorology, Craig for mathematics, or "the intelligent author of 'The Traveller's Remembrancer,'" for anything whatsoever. We neither know their names, nor recognise their authority. We do not use such terms as *hydroguret, electrology, fluate of lime, hydropneumatic, physicologist*, nor do we include hydrostatics in hydrodynamics (p. 184). This is partly the science of another age, partly the science of no age at all.

And now, before leaving the work, let us return once more to the introduction. It is headed by what we suppose is the key-note of the work, the phrase which Colonel Newcome loved to quote, which the Padre Cura of Guadarrama persisted in attributing to Cicero, and which comes to most of us at an early age *viâ* the Latin grammar, and the syntax therein, and the troublesome nominative to the verb:—

> "Didicisse fideliter artes
> Emollit mores, nec sinit esse feros."

But why has our author omitted the "*Ingenuas?*" Injured shade of Ovid, you have our sympathy. Are not the arts of which he treats ingenuous? We feel bound to confess that they could not be learnt faithfully from the work before us if they were, so perhaps it is as well to maim the lines altogether; and we would further (with apologies to the reader) state that the learning of the arts, especially those appertaining to the extracts given above, out of this book has quite a reverse effect to that conveyed by the Ovidian maxim, for it makes us exceedingly *feros*. Not far removed from "Didicisse, &c.," in the Latin grammar, our author may remember another phrase, which he may be inclined to say to us after perusing the above remarks: "Vos damnâstis; (*quasi dicat* præterea nemo") but we assure him in this case the nominative of the pronoun need not be expressed; it is not we alone who have condemned; we must say *Damnaverunt* without the pronoun, and we regret it for his sake.

First Lessons in Inorganic Chemistry. By T. Ward, F.C.S., &c. Manchester: John Heywood. London: Simpkin, Marshall, and Co. 286 pages.

There is already more than a superabundance of small text-books and manuals on chemistry; and it is a matter for wonder that, while there is no lack of really excellent books for young pupils, so many authors rush into print, imagining that they can improve upon what exists, and evidently forgetting "*Comment fait on des livres? Avec des livres.*" Let us briefly glance at the contents of this little volume. It partakes, in its arrangement, of two excellent works—viz., Stöckhardt's well-known book, and the small volume written by Professor Roscoe. We are sorry to be compelled to say that Mr. Ward's book is inferior to each of these, individually, as it is deficient in that lucid and precise clearness of exposition and soundness of definition which so eminently characterises the two works just alluded to. While we thus express our opinion, we must in all fairness also say that, as far as we have perused Mr. Ward's book, we have not found therein any heterodox or incorrect statements. The book is well got up, is provided with woodcuts, and contains some very useful tables relating to weights and measures, thermometer degrees, and a copious index. There is also added a chapter on qualitative analysis, which is, however, too brief to be of much use.

An Introduction to the Study of Chymistry, written for the People. By Cuthbert C. Grundy. London: Simpkin, Marshall, and Co. 1870. 108 pages.

Our first remark applies to the use and spelling of the word *chymistry*. Although the origin, or primitive meaning of this word is not satisfactorily explained, there is little doubt about the proper spelling, omitting even for the moment so old an origin as that which is sometimes assigned to chemistry as the Egyptian art, or as the secret art of transmutation, as practised by the Chémi (the Koptic for Egyptians). It is undeniable that Zosimus, in the fifth century of our era wrote χημεια, derived from χεω, or χεεω (*to melt*, or *to fuse*); but there certainly is no warrant for using the *y*, since neither the Greek substantive nor the verb contains the υ placed as this author would have it. As to the contents of the book, while admitting that there is in it a large amount of useful information, it is equally true that it is, in many respects, a curious *olla podrida*: and this especially applies to the attempt evidently made of compressing a great deal into a very confined space. On page 20, we read—"There are two kinds or classes of matter. Matter which has been formed by the action of animals or of plants, or which is part of an animal or of a plant, is called organic matter; because it is a part of the substance of the organs of the animal or of the plant, or is produced by these organs. Wood is an organic substance, because it is a part of the plant; starch is organic matter, because it is formed by the organs of the plant; flesh is organic matter, because it is part of the animal." It would seem that the author has no idea of the distinction to be made between *organized* and *organic* substances or matter. The book is by no means free from incorrect statements—*e. g.*, page 83 we read—"For chlorine cannot bleach mineral colours." How, then, does it act upon ultramarine, or upon Scheele's green? Of phosphorus, we read that it can be obtained in the free state only by artificial means; this is, of course, quite correct, but this equally applies to silicon, of which it is said it is not found in free state, while, according to the author, boron is not known in free state—a statement which is quite incorrect, for it may be obtained in the free state by artificial means just as well as phosphorus and silicon.

The appendix is the best, and, in many respects, most valuable part of the book, since in it are given the rules applying to decimal fractions, the decimal system of weights and measures, and the value thereof according to the English system. The author has, we fear, written rather hurriedly; and, by trying to compress too much information in a small space, sacrificed that clearness which should characterise a book of this nature intended for the great body of the people.

CORRESPONDENCE.

Monad Elements.

To the Editor of the Chemical News.

Sir,—In the Chemical News (vol. xxi., p. 80; *Am. Repr.*,

April, '70, *page* 205), Mr. George Davis has touched upon a subject especially interesting to me, as, during the last thirteen months, I have made it my study. Many circumstances (among which a prolonged absence in the country, away from all books of reference, and a wish to collect more and more evidence in their support) have combined to defer the publication of my views of the so-called monad elements; I hope, however, now speedily to make them known. I may shortly state that, by assuming triad functions for the univalent class of bodies, I have been able to explain the existence of many compounds hitherto unclassified and regarded, as Mr. Wanklyn says, as "freaks of nature."—I am, &c.,

WALTER NOEL HARTLEY.

Dr. Odling's Laboratory, Royal Institution,
February 23rd, 1870.

Shell Sand from the Island of Coll.

To the Editor of the CHEMICAL NEWS.

SIR,—In the report of my short paper on "Shell Sand" in your last number, there is an error which I beg you will allow me to correct. I did not say that shell sand formed a strong mortar with lime, but that a strong lime was made from it by stacking it alternately with peat, and burning the stack; and that this lime, from the magnesia and silicic acid it contained, was in use almost equal to a cement.—I am, &c,

EDWARD C. C. STANFORD, F.C.S.

Edinbarnet, Dumbartonshire, N.B.
February 28, 1870.

[The report was forwarded by the gentleman nominated by the Council to do so.—*Ed. C. N.*]

The Rashness of Scientific Men.

To the Editor of the CHEMICAL NEWS.

SIR,—Your well-written and excellent contemporary, the *Spectator*, said, last week, that "it seems as if no class of men drew rasher or hastier conclusions than the men of science." This was *apropos* of a recent statement as to the effect of hard and soft water upon the human constitution. Now I should very much like to know who originated this statement. Surely, if a physician, he could not have been a chemist, and, if a chemist, no physician. The *Spectator*, generally intelligent and well informed, persists, like the *Times*, in speaking of druggists as chemists, and probably shares, too, the popular opinion that a doctor necessarily knows all about analysis and the arcana of chemical science. The investigation of the present case will, I feel confident, result in showing that the rash and hasty conclusion complained of was not drawn by a genuine man of science competent to connect a chemical fact with a physiological phenomenon. There are too many *fungoid* or pseudo-scientific men, who seize upon the results of true philosophers, and misinterpret them to the popular theme.—I am, &c.,

C.

A New Dentists' Alloy for Stopping Teeth.

To the Editor of the CHEMICAL NEWS.

SIR,—I have recently examined a new dental alloy which is sold for the purpose of being used as the basis of an amalgam. It occurs in the form of rather coarse filings, nearly white. Warmed in an iron spoon with a little mercury, it soon enters into intimate commixture with it. The warm amalgam, if then pressed in wash-leather in a pair of pincers, loses much mercury, and the dry amalgam thus obtained is ready for insertion into the cavity to be stopped. Its manipulation altogether much resembles that of the celebrated copper amalgam, and it seems to be quite as useful though not so hard. But it possesses this advantage over the copper amalgam (which darkens greatly) that the new amalgam retains its whiteness in the mouth. On analysis the original metal as sold gave:—

Tin.....	61·12	per cent
Silver.....	38·76	" "
Copper, &c.,.....	0·12	" "
	100·00	

I am, &c.,

C.

Memorial or Monument?

To the Editor of the CHEMICAL NEWS.

SIR,—It is reported that the Faraday Memorial, for which about £1,100 has been subscribed, is to take the form of a "Monument in the British Museum." I hope the report is not authentic. The project is inappropriate, useless, almost ludicrous. Faraday hated monuments, and the British Museum, which has no department of chemistry or physics, is about the last place where one would expect or wish to see a statute of our great natural philosopher. The best memorial for a great worker would be the creation of a reward or stimulus for further work. Why not found a Faraday Scholarship, or award annually a money grant and medal for a great discovery in chemistry or physics? Whatever be done should be in connection with the Royal Institution, the scene of Faraday's life and labours. The experience of the Wollaston Fund which is connected with the Geological Society, affords an excellent precedent for the present case. Our English experience in busts and statues (especially when posthumous) is not so happy as to encourage us to risk an additional failure.—I am, &c.,

A SUBSCRIBER TO A MEMORIAL,
NOT A MONUMENT.

Quantivalence of Sodium, &c.

To the Editor of the CHEMICAL NEWS.

SIR,—From the letters of Mr. G. E. Davis, and Mr. Noel Hartley, which have recently appeared in the CHEMICAL NEWS, it would seem that these gentlemen consider that there is something quite new in regarding sodium, potassium, &c., as capable of acting as triads and pentads. Now, I respectfully submit that there is no great novelty in the matter; such views having been put forth by several chemists at various times, but, without going further into the subject, I will simply call attention to a paper which I wrote on this question (CHEMICAL NEWS, vol. xvi., p. 43, July 26, 1867; *Am. Repr., Sept. '67, page* 128), with the object of showing "that reputed monads may, under certain circumstances, play the part of triads and pentads. Indeed, anyone who considers such compounds as that of potassium with hydrogen and fluorine, KHF_2, and that of silver with hydrogen and iodine, $AgHI_2$, can hardly fail to regard one at least of the elements so combined as acting, for the time being, the part of a triad. Professor Wanklyn, however, is not content with regarding sodium as occasionally capable of triadic functions; he seems to argue that it is never a monad, and this extreme view appears to be quite untenable in the present state of science.

One word, in conclusion, with reference to the two classes into which Dr. Williamson has divided the elements, viz, those of even and uneven quantivalence, or, as Dr. Odling calls them, artiads and perissads; I believe that there is no hard and fast line between these two classes, and could produce

evidence on this point, but will, at present, merely remark that quantivalence must be regarded as a state or condition of matter, and not as an unalterable property attached to this or that element.—I am, &c.,

JOHN A. R. NEWLANDS, F.C.S.

13, Knowle Road, Brixton, S. W.
February 28, 1870.

Treating Excreta of Towns.

To the Editor of the CHEMICAL NEWS.

SIR,—I have just been shown an article in the CHEMICAL NEWS of October 22nd, 1869 (vol. xx., p. 196; *Am. Repr., Dec. '69, page* 347), on "A Chemical Method of Treating the Excreta of Towns," by Edward C. C. Stanford, F.C.S. It may be interesting to your readers to have a short description of the system of conservancy I have persistently been trying to introduce into India for the last eighteen months. I must premise that, in tropical climates, the evils of the water sewage are greatly increased. The water with which the sewers are flushed is hot; putrefactive fermentation takes place very rapidly, as, also, does fungoid vegetation. The system I propose is to carbonise the filth in retorts, and to utilise the gas for heating the furnace and for illuminating. The filth is thoroughly deodorised, by means of the poudrette coke (the residue left in the retorts), and can be carried in carts or open vessels to the carbonising apparatus. In order to obtain an extra quantity of gas for heating the furnace, I purpose either making the retorts reciprocating, or using double retorts, with mouth-pieces, lids, and ascension-pipes at both ends; by this means, the charge of one retort, or of half a double retort, can be so arranged that the steam first given off will pass through and over the incandescent poudrette coke lying in the other half, or in the reciprocating retort, as the case may be. By this means, the steam becomes decomposed and forms two gases, hydrogen and carbonic oxide. There must be stop-valves in the ascension-pipes to carry out this arrangement. I have always insisted that the poudrette coke, surcharged with ordine, will give a highly-luminous gas. I am now preparing a project for the conservancy of the Cantonment of Dum-Dum, by order of the Viceroy in Council, and will send you full particulars of the result.

It may be thought that if the carbon be used to make carbonic oxide by decomposing the water, it will not be available as poudrette coke for deodorising fresh filth; but one, or a pair of retorts, loaded and so used, out of a group of five, will give sufficient gas for heating the furnace. For Dum-Dum, I propose having a group of five retorts (double), with a furnace-grate for coke at one end and a pipe passing in for gas at the other end through the back wall. There is a condenser, with a tank for collecting the tar and ammoniacal liquor; a dry-lime purifier, for getting rid of any carbonic acid; and a small gas-holder, for regulating the supply of gas to the furnace.—I am, &c.,

W. R. GILBERT HICKEY, C.E.

Calcutta, Feb. 1st, 1870.

Manufacture of Sulphuric Acid.

To the Editor of the CHEMICAL NEWS.

SIR,—With your correspondent Mr. Gibbins I saw the objections to Dr. Hofmann's improvement in the manufacture of sulphuric acid. Still the advantages to be derived from it, especially in the present condition of the nitrate market, are so large that I at once decided on giving it a fair trial, and am now arranging my vitriol chamber so as to obviate one of the difficulties named by your correspondent, and which, if not provided for, would probably be fatal.

The description will, probably, explain my object:—I have, say, six vitriol chambers at work, nearly all of large sizes; into No. 1 I work one set of furnaces and into No. 2 another set. The gases from No. 1 and from No. 2 meet in No. 3; this and No. 4 I shall work up to 1·715 specific gravity—Nos. 1 and 2 will work at 1·45; all the acid produced in No. 3 will be passed into No. 1 and all produced in No. 4 into No. 2: the acid of 1·715 as it mixes with that of 1·45 will give up its nitric oxide, which thus at once becomes again available and the acid can then be run off for use from Nos. 1 and 2 in ordinary condition. The strong action having taken place in Nos 3 and 4 I shall work 5 and 6 at a lower strength in order to ensure condensation. I shall thus I hope reduce Dr. Hofmann's very valuable suggestion to a rather more practical shape, and if I can by even partial success save, say, a couple of tons of nitrate of soda per week, I shall gladly renew my chambers a year sooner than would otherwise be needful.—I am, &c.,

PETER SPENCE.

Pendleton, Alum Works, Manchester,
March 21, 1870.

Action of Iodine on Hyposulphite.

To the Editor of the CHEMICAL NEWS.

SIR,—In a paper by C. R. A. Wright, published in the CHEMICAL NEWS (vol. xxi., p. 103; *Am. Rep., May, '70, page* 247), reference is made to a paper "On the Estimation of Manganese," published in the CHEMICAL NEWS (vol. xx., p. 302; *Am. Rep., Feb.* '70, *page* 82), in which the authors say:—"In estimating the manganese by the method of Bunsen, the iodine liberated by the chlorine should be tested as soon as possible after the decomposition," the iodine solutions in each of two experiments requiring an amount of hyposulphite corresponding to 62·7 per cent of available peroxide in the manganese ore assayed, when tested immediately after the decomposition, and to over 65 per cent after standing twenty-four hours. "This was caused by the conversion of iodine into hydriodic acid."

In a note published in the CHEMICAL NEWS (vol. xxi., p. 48; *Am. Rep., March* '70, *page* 176), and which seems to have escaped Mr. Wright's notice, the following explanation of this is given:—

"These higher results are caused by the liberation of iodine by spontaneous decomposition of hydriodic acid set free by hydrochloric acid distilled over during the process, as the following experiment shows:—A few drops of hydrochloric acid were added to a solution of iodide of potassium. The solution remained for some hours colourless, but, after standing twenty-four hours, had become quite yellow, and was found to contain free iodine sufficient to indicate 3 per cent of peroxide of manganese when titrated with hyposulphite.

Mr. Wright's experiments, though very interesting, do not in the least "account for the results obtained by Messrs. Sherer and Rumpf," since the conditions were not identical. —I am, &c.,

EDWARD SHERER.

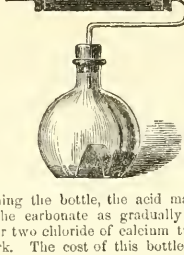
4, St. Nicholas Buildings,
Newcastle-on-Tyne, March 21st, 1870.

LABORATORY NOTES.

NEW APPARATUS FOR THE ANALYSIS OF CARBONATES.

So many forms of apparatus for the analysis of carbonates have been devised that it is just possible the one which is shown in the engraving may have been already suggested. In Griffin's "Chemical Handicraft," sixteen kinds of apparatus for this purpose are described, but not one of them is of so simple a construction as that which I propose. Fritzsche's is almost as simple as mine, but it is not so manageable.

My apparatus is a light bottle, of the capacity of 75 centimetres. The lower part is divided into two compartments; in one of which the carbonate is placed, in the other the



acid. By inclining the bottle, the acid may be allowed to flow over on the carbonate as gradually as the operator pleases. One or two chloride of calcium tubes are inserted through the cork. The cost of this bottle would be about 6d.

Charles A. Cameron, M.D.,
Analyst to the City of Dublin, &c.

MISCELLANEOUS.

Chemical Society.—The following is the Council's list for the election of officers on March 30th, 1870:—President—A. W. Williamson, Ph.D., F.R.S. Vice-Presidents who have filled the office of President—Sir B. C. Brodie, F.R.S.; Warren De la Rue, Ph.D., F.R.S.; A. W. Hofmann, D.C.L., F.R.S.; W. A. Miller, M.D., D.C.L., V.P.R.S.; Lyon Playfair, M.P., Ph.D., C.B., F.R.S.; Col. P. Yorke, F.R.S. Vice-Presidents—E. Frankland, Ph.D., F.R.S.; J. H. Gilbert, Ph.D., F.R.S.; A. Matthiessen, Ph.D., F.R.S.; H. M. Noad, Ph.D., F.R.S.; W. Odling, M.B., F.R.S.; T. Redwood, Ph.D. Secretaries—A. Vernon Harcourt, M.A., F.R.S.; W. H. Perkin, F.R.S. Foreign Secretary—H. Müller, Ph.D., F.R.S. Treasurer—F. A. Abel, F.R.S. Other Members of Council—E. Atkinson, Ph.D.; H. Bassett; E. T. Chapman; David Forbes, F.R.S.; F. Field, F.R.S.; Dr. M. Holzman; E. J. Mills, D.Sc.; W. J. Russell, Ph.D.; Maxwell Simpson, Ph.D., F.R.S.; R. Angus Smith, Ph.D., F.R.S.; A. Voelcker, Ph.D.

Flower Farms—Premiums for Odours of Plants.—The following premiums have been placed at the disposal of the Council of the Society for the Encouragement of Arts, Manufactures, and Commerce, for the term of seven years, by Dr. Septimus Piesse, F.C.S.:—1. A premium of £5, for one pound of otto of bergamot, of the value of 16s or more in the London market, being the produce of plants (*Citrus Bergamia*) grown in Australia, New Zealand, Natal, any of the British West India Islands, or any other British Colony or Dependency. 2. A premium of £5, for 1 oz. of otto of roses, of the value of £1 or more in the London market, being the produce of any variety of roses grown together in one plantation in the above-mentioned Colonies. 3. A premium of £10, for a canister of enflowered butter or fat, so scented with any kind or sort of flower, either by infusion or enfleurage, or by means of these processes jointly, of the weight of 3 lbs. or more, and of the value of 6s. per lb. in London; the said butter or fat to be enflowered or infused with flowers grown for the purpose in the British Colonies.

On the Use of Ether as an Intoxicant in the North of Ireland.—We have received from Mr. H. N. Draper a pamphlet on the above subject from which we learn that the use of methylated ether instead of alcohol is very general in the counties of Londonderry, Antrim, and Tyrone. The quantity taken at one time is from two to four drachms and the dose is repeated twice, thrice, or even four and six times daily. Mr. Draper treats the subject in its relation to the Inland Revenue and also to insurance companies, the former suffering by the practice to the extent of £5666 per annum, while the risks of the latter are increased by such an inflammable liquid being stored and handled by people ignorant of its properties.

Water Supply of London.—We have received from Dr. Letheby his report on the sanitary condition of London, in which he says the chemical composition of the metropolitan water has not fluctuated to any considerable extent: for that derived from the Thames and the Lea has contained from 21 to 23 grains of solid matter per imperial gallon during the winter months, when the rainfall is the greatest, and from 17 to 17·5 grains per gallon in the summer, when it is least, the average for the whole year being about 19·3 grains per gallon, of which about 14·2 grains are calcareous salts, giving that degree of hardness to the water, the hardness being reduced to about 3·8 degrees by boiling the water for a quarter of an hour. The proportion of common salt in the water does not exceed 1·8 grains per gallon, and the organic matter, as estimated by the oxygen required to oxidise it, is not above two-thirds of a grain per gallon. The nitrogenous matter also is remarkably small, ammonia being in the proportion of only one part to about 35,000,000 parts of water, and the nitrogen, as nitrates, &c., as one to 630,000 parts. The water supplied to the public is for the most part clear and colourless; on one occasion, however, during the year, it was slightly turbid in the case of the Grand Junction water; on two occasions with the Southwark and Vauxhall water; on four with the Lambeth; and on six with the Chelsea. The daily supply of water to the metropolis has ranged from 91,578,341 gallons per day, in the month of January last, to 110,094,038 gallons in the month of July, the average for the whole year being rather more than 99,000,000 of gallons per day, or 31·2 gallons per head of the population. The daily supply to Paris averaged 46,561,472 gallons per day, or 24·6 gallons per head of the population; but this includes the water supplied to the public fountains, ornamental waters, &c. The number of houses supplied daily by the water companies of London is about 463,000. Rather more than half of the water is obtained from the River Thames at Hampton, and the rest is from the Lea, and from springs and wells in the chalk. The supply to Paris is derived chiefly from the Canal d'Ourcq and the River Seine. None of the Paris water is filtered, and is always more or less turbid when it reaches the consumer. In London, however, the water is filtered, generally in a very effective manner. It is remarked that, except in special cases, water of moderate hardness, like that supplied to the metropolis, to Paris, and Vienna is always preferred, and is best suited for domestic purposes, because of its being brighter to the eye and more agreeable to the taste. So satisfied, indeed, were the French authorities on this head, that they passed by the soft waters of the sandy plains near Paris, and went far away to the chalk hills of Champagne, where they found a water which is even harder than that supplied to London. One important consideration which strongly influenced them in their decision was the fact that more consciptis are rejected in the soft water districts, on account of imperfect development and stunted growth, than in the hard; and they conclude that calcareous matter in water is essential to the formation of tissues. In this country, also, it is remarkable that, wherever soft water is supplied to the people, the mortality is large, even when allowance is made for the birth-rate of the place. Glasgow, for example, as well as Preston, Dundee, Sheffield, Plymouth, Manchester, Bradford, &c., which are all supplied with water of less than 4 degrees of hardness, have a mortality which ranges from 26 to 34 per 1000, while at Birmingham, Bristol, Sunderland, Newcastle-on-Tyne, Wakefield, Dover, Norwich, Croydon, Worcester, Derby, and other places, where the waters are hard, the mortality is considerably less; in fact, it may be said that in towns supplied with water of more than 10 degrees of hardness, the average mortality is about 22 per 1000, while in those supplied with softer water it is about 26

per 1000. It may well be, as the late Professor Johnson observed, that "the bright sparkling hard waters which gush out in frequent springs from our chalk and other limestone rocks are relished to drink, not merely because they are grateful to the eye, but because there is something exhilarating in the excess of carbonic acid they contain and give off; and because the lime they hold in solution removes acid matters from the stomach, and thus acts as a grateful medicine to the system. To abandon the use of such a water, and to drink daily in its stead one entirely free from mineral matter, so far from improving the health, may injure it. The water of a country may determine the diet of its inhabitants. The soft water of the lakes of Scotland may have had much to do with the use of brown meal; and but for the calcareous waters of Ireland the potato could not have become a national food." Looking at the plain teachings of all this, and considering the excellent quality of the water supplied to this metropolis, it would be folly, in my opinion, to change it for a soft water. On the other hand, it is quite possible to have an excess of calcareous and other saline matters, as is the case with the well waters of this city, where the proportion ranges from 48 to 120 grains per gallon. Dr. Letheby concludes with a report of the sanitary work done in the city during the year.

The Royal Society.—The president gave the first *soirée* of the season on Saturday evening last at Burlington House. There was a large attendance of visitors, and a number of objects of scientific interest were exhibited. Mr. Browning's display included an improved large automatic electric lamp, in which the carbon points are drawn asunder, and their distance regulated solely by the force of the electric current employed; transparent stereograms on glass, of a globe of the planet Mars; water-colour drawing of Jupiter, exhibiting the ochreish-yellow or tawny belt, now visible near the equator of the planet; arrangement of spark condenser, in connection with a condenser in box to take the Leyden jar, the upper part to unscrew and pack in lid of box—the advantages are perfect insulation, large surface in small space, freedom from liability to fracture, portability; bright cross micrometer for measuring the position of lines in faint spectra; by using this instrument only the cross is seen illuminated, and the light of the spectrum is unimpaired; spectrum of pure gold, shown in a chemical spectroscope, this instrument has been arranged specially for use in a laboratory, the prism is provided with a very closely fitting cover, and the prism can be removed from the plate and a prism of any other substance introduced instead, for the convenience of taking refracting indices and dispersive powers. The India Rubber Company showed the Leclanché battery. The vacuum tubes shown by Mr. Apps attracted considerable attention. Mr. Ladd showed his new form of electric lantern recently described in these columns. This maker also showed a new form of micro-spectroscope. Mr. W. Chandler Roberts, the chemist to the Mint, exhibited remarkable specimens of electro-deposited iron, prepared by M. Jacobi, of St. Petersburg, and himself. The metal is sufficiently hard to scratch glass. The application of hard iron plates for printing purposes was illustrated by some extremely fine proofs. This material possesses great advantages as an art material. Specimens of electro-iron converted into steel were also shown.

Death of Dr. Redtenbacher.—We regret to have to announce the death of Joseph Redtenbacher, M.D., &c., Professor of Chemistry at the University of Vienna. The deceased was born on March 12th, 1810, at Kirchdorff (Austria), and held, since 1849, the Chair of Chemistry just alluded to. He was well known as the author of a large number of scientific memoirs and papers, and was a member of the Imperial and Royal Academy of Vienna from the date of its foundation, some forty years ago.

New Dictionary of Science.—Messrs. Moxon and Co. are preparing for publication a Dictionary of Science, edited by Mr. G. Farrer Rodwell. It will be uniform with Haydn's "Dictionary of Dates" and "Dictionary of Biography," and will comprise—Acoustics, Astronomy, Chemistry, Dynamics, Electricity, Heat, Hydrodynamics, Hydrostatics, Light, Magnetism, Meteorology, Pneumatics, Statics. These subjects will be treated of by—J. T. Bottomley, M.A., Lecturer on Natural Science in King's College School; William Crookes, F.R.S., &c., Frederick Guthrie, B.A., Ph. D., Professor of Natural Philosophy in the Royal School of Mines; R. A. Proctor, B.A., F.R.A.S.; Richard Wormell, B.A.; and the Editor.

Gold-Smelting in Irkoutsk, East Siberia.—MM. Basnin and Lomonossoff have opened a private laboratory, in Irkoutsk, for the technical study of the minerals, &c., of the country—*i.e.*, the determination of ores, salts, solutions, manures, and materials for building and heating (the determination of paraffin in asphaltum is included). The laboratories are large, and fitted up with all the necessary apparatus. The titration method will be exclusively used for technical analysis of useful minerals; as far as this method extends, MM. Lomonossoff and Basnin have promised to send us an account of the results of their labours from time to time.

A Soda Mine.—Some two miles north of the Sand Springs Road, and fifty miles east of Virginia and Gold Hill, is an immense and apparently inexhaustible deposit of almost pure soda. It is owned by parties in Carson and Virginia, who use it in the manufacture of soap, and also supply quartz mills with it as a chemical agent in the reduction of ores. They also supply it to drug and grocery stores, where it is sold for washing and other proposes for which common soda is ordinarily used. It is free from all earthy matter, and consists of 80 per cent soda, the balance being salt, or something of the sort. The deposit is in the midst of an alkali flat, of some 17 acres in extent, and at the surface it appeared only about 3 feet wide, or rather more like a soda spring than anything else, the pure article forming in a crust over and about the strong watery solution. Upon digging beneath this, however, the solid soda was discovered in a defined mass, like a quartz ledge. A shaft has been sunk beside it to the depth of 50 feet, from the bottom of which a drift has been made 25 feet into the vein or deposit of soda, without getting through it; in fact, very little is known of the depth or extent of this huge deposit of soda, except that there is apparently a million tons or more of it in sight. The enclosing walls on each side are very distinctly defined, and are simply composed of a dark, heavy, compact, iron sand, strongly impregnated with soda. This deposit is as singular as it is valuable, and goes to show how little the varied and inexhaustible resources of our young State are as yet developed.—*Gold Hill News.*

Manufacture of White Lead.—An invention is at present being tested by which ordinary galena, after having been crushed in an ore crusher, is roasted in a desulphurising kiln, and next mixed with carbon (preferably in the state of fine-washed pea or dust anthracite coal) in the proportion of half and half. This mixture is heated in a peculiarly-constructed furnace; and the dense white vapours which are given off are conveyed into a separate chamber, and strained, by passing through bags or screens of muslin, or are allowed to deposit slowly, and, after cooling, collected, as in the case of the manufacture of zinc-white.

Science in the Nineteenth Century!—The following advertisement, taken from the pages of a contemporary, is too good a joke to be lost:—"British Science having been for some time suspected of owing much of its reputation to the indifference of the general public on philosophical subjects, the truth or accuracy of which it has had no special means of acquiring practical information, or has been more or less blinded by an overweening confidence in the supposed skill of paid officials or royal Professors, several gentlemen have made it their business, at a great cost of time and labour, to investigate the grounds on which the various Astronomical and Geographical Societies have based many

of their principal theories. The *assumed* convexity or curvature of the earth's surface is found to be as gross a delusion as its supposed orbital and axial motion;—That it is nothing but a stationary plane of hill and dale and level, over the face of which the sun and moon and stars revolve; that Ptolemy and the ancient Greek philosophers were the only truthful and trustworthy authorities on matters of astronomical science, and that the later theories of Galileo and Sir Isaac Newton are directly contrary to Scripture, to reason, and to the positive evidence of our senses. Those who require or are disposed to accept further particulars, are requested to communicate with ——, enclosing Three Stamps, for pamphlets and postage; with lists of larger works on this subject. Literary and Philosophical Societies will do well to disabuse their minds of the impression that they can much longer resist and resent the growing demand for a thorough revision and re-construction of their antiquated and erroneous systems."

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the month, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note.—*All degrees of temperature are Centigrade, unless otherwise expressed.*

Bayerisches Industrie und Gewerb-blatt, September to December, 1869.

The greater portion of these numbers is occupied by the publication of laws and other official matters relating to Bavaria. Among these, we meet with very complete and well got up instructions for the inspectors of weights and measures in consequence of the introduction of the decimal system. A large portion of these numbers is devoted to regulations relating to technical instruction, which is carried out to a very high degree in this kingdom.

Application of Heat to Mechanical Labour.—Dr. Linde.—A valuable contribution to the better utilisation of heat to be converted into mechanical force.

Technical Application of Coke obtained from Peat.—Dr. Vogel.

The More Recently Discovered and Valuable Metallic Alloys.—Dr. Fürtenbach.—This very lengthy paper is an excellent compilation on this subject.

Comptes Rendus des Séances de l'Académie des Sciences, February 14, 1870.

This number contains the following papers relating to chemistry and allied sciences:—

Galvanic Element with Three Fluids. — F. Zaliwski.—This contrivance consists of two porous cells placed one inside the other and surrounded by another suitable vessel. The inner vessel contains nitric acid and a piece of carbon; the intermediate vessel contains sulphuric acid; and the outer vessel a solution of sal-ammoniac in water and a piece of zinc. The author states that this arrangement is very superior to a Bunsen cell.

Accidental Images of White-Coloured Objects.—J. M. Segniu.—A continuation of a former paper on this subject.

Geological and Agronomical Map of the Department de la Haute-Vienne.—J. Mallard.—M. Elie de Beaumont calls the attention of the meeting to this map, on account of the excellent manner in which it has been executed by means of chromo-lithography. The description given is too lengthy for full reproduction here; but the utility of such local maps, executed with minute accuracy and on a large scale, must be evident.

Fusion of Platinum.—Dr. St. Claire-Deville states that an error has accidentally been made in the *Compte Rendu* of the last meeting, and that it is the oxygen, not the hydrogen, dissolved during the fusion of platinum, which gives rise to this metal, presenting the same phenomenon as molten silver—viz., scintillation and spirting while in the molten state.

New-Electro-Magnetic Apparatus.—A. Demoget.

Description of an Apparatus for Registering, by Photography, the Reading of the Barometer.—P. Volpicelli.

Historical Notes on the Radiation of Heat from the Moon.—P. Volpicelli.—After referring to the opinions of Virgil, Dante, Tasso, Marini and Guarini, who denied the possibility of heat emanating from the moon, the author quotes, from the works of Aristotle, Aquino, Pic de la Mirandolle, and Cardan, who, although not enabled to prove, experimentally, any facts relating to this matter, yet admitted that heat emanated, to some degree, from the moon. Dr. Hooke was the first who called attention to this subject, by some observations and experiments; and Geminio Montanori (born, 1632; died, 1687) states, in his "L'Astrologia Convinta di Falsità," that the heat emanating from the moon can be readily made perceptible by means of a large air thermometer and a powerful lens. In our days, the author says, it was Melloni who, on the 23rd of March, 1846, has incontrovertibly proved, by experiments, that the moon radiates heat.

Double Crystals Exhibited by Snow.—J. Girard.

Action of Green Light upon the Mimosa Pudica.—P. Burt.—The plants are placed under glass jars constructed of variously-coloured glass. The chief fact observed in respect of these very sensitive plants is that, by being covered with a green-coloured glass jar, the plant rapidly becomes insensible, and dies in a very short time.

Solar Spots Visible by the Naked Eye.—Tremeschini.—By simply making use of a coloured glass, the author states that these spots can be seen very well; the diameter of the largest was, on the 11th instant at 9 a.m., 0° 3'45', and on the 14th at 10 a.m., 0° 4'50'.

By far the greatest portion of this number is occupied by essays on geometrical, mechanical, and mathematical subjects; and there is no paper strictly relating to chemistry.

Journal für Praktische Chemie, No. 16, 1869.

This number contains no original papers.

No. 17, 1869.

On the Lead Salts of Formic Acid.—Dr. Barfoed.—The author describes:—Neutral formiate of lead.—According to what is stated on the solubility of this salt in treatises on chemistry, it is soluble in 36 parts of water; but, according to the author's experiments, this salt, prepared with proper care, requires for solution 63 parts of cold water, while it requires $5\frac{1}{2}$ parts of boiling water for solution. This salt is, moreover, gradually decomposed by being boiled; formic acid escapes, and a basic salt remains. Bibasic formiate of lead is obtained when an aqueous solution of the neutral salt is treated with its equivalent weight of oxide of lead; it is readily obtained in large crystals, which are, however, easily acted upon by the carbonic acid of the air. The formula is $2PbO,C_2HO_3$. 1 part of this substance requires 58·5 parts of cold and 10 parts of boiling water for solution; it is insoluble in alcohol, as is likewise the neutral salt. Tribasic formiate of lead is obtained by boiling a solution of the neutral salt with two equivalents of oxide of lead; this substance is obtained in small acicular

crystals, soluble in 25½ parts of cold, and 7½ of boiling, water; formula, $3PbO,C_2HO_3$. Quadribasic formiate of lead, $4PbO,C_2HO_3$.—1 part of this salt requires 104 parts of cold water for solution; it is insoluble in alcohol.

Estimation of Nitric Acid in Spring Waters.—Dr. Fleck.—The method, described at great length, is based upon the fact that, according to the author, the nitric acid present in spring waters is chiefly combined with lime or magnesia, and rarely only with alkalies. Use is made of the well-known fact that a solution of sulphate of potassa yields, when mixed with a solution of nitrate of lime, gypsum and nitrate of potassa, which, in its turn, when ignited in the presence of organic substances, is converted into carbonate of potassa; while, lastly, the carbonate of potassa thus formed can be quantitatively estimated and is proportional to the quantity of nitric acid present. The reagents required for the execution of this method are—Normal nitric acid and normal caustic soda solution, each at from 4 to 5 per cent; a solution of sulphate of potassa, 5 grms. to 100 c.c. of water: perfectly pure sugar. According to the statements made in this lengthy essay, this method appears to be a useful addition to quantitative chemical analysis.

A New Salt from Hallstadt (Austria).—Dr. Simony.—This mineral occurs along with rock-salt, anhydrite, and a somewhat weathered sulphate of soda; its colour is bluish green; formula, $MgSO_4,Na_2SO_4,4H_2O$. This salt is not affected by exposure to air, and loses, even at 100°, only a portion of its water. Although, therefore, this salt has the same percentage composition as astrakanite, it has a different constitution. The three now known naturally-occurring double salts of the sulphates of soda and magnesia are, therefore—

$MgSO_4.Na_2SO_4.4aq.$ astrakanite, or Bloedite;
$2MgSO_4.2Na_2SO_4.5H_2O.3aq.$ Simonyite (the salt just discovered);
and $2MgSO_4.2Na_2SO_4.5H_2O$, Loewite.

Synthesis of Hydroxylamine.—Dr. Ludwig.—The author has succeeded in directly combining nascent hydrogen and dentoxide of nitrogen, $NO+H_3=NH_3O$. This is effected by passing pure dentoxide of nitrogen through a mixture of tin and hydrochloric acid; the tin is removed by sulphuretted hydrogen, the filtrate is evaporated to dryness, and the residue taken up with alcohol. The chloride of ammonium is removed by chloride of platinum, and the hydroxylamine is precipitated with pure anhydrous ether.

Action of Chlorine upon Absolute Alcohol while Exposed to Direct Sunlight.—MM. Streit and Franz.—While engaged in making hydrate of chloral with absolute alcohol, direct sunlight accidentally fell upon the apparatus, the temperature of the contents of which was 62°. The continued action of the sun's rays caused a series of sharp detonations, accompanied by very bright lightning-like flashes inside the apparatus; the fluid, previously quite clear, became black, a blackish powder was separated, and the temperature rose to 78°. The authors repeated the experiment with artificial light, and found that magnesium light, the light emitted by a mixture of sulphide of carbon and dentoxide of nitrogen while burning, electric light, and the light emitted by the ignition of a mixture of chlorate of potassa and sulphur, when ignited produce the same effect. The products of the decomposition of the alcohol were not further investigated, but exhibited a most frightful stench and a deep reddish brown colour.

Revue Hebdomadaire de Chimie, February 10, 1870.

Process for Rendering Various Substances Waterproof.—M. Ch. Toppan.—This contrivance consists, essentially, in the employment of a solution of pure paraffin in naphtha—that is to say, light petroleum oil—and to steep the objects required to be waterproof in this solution.

Estimation of Starch in Bread.—J. Mayer.—The method proposed by the author is that of converting the starchy matter into glucose, by means of boiling, say 5 grms. of the bread, with water containing 1-20th of its weight of sulphuric acid. The liquid is kept boiling for a considerable time, and from time to time a small quantity is tested with iodine; when, as the latter substance fails to indicate the presence of starch, the ebullition is kept up for some time longer, and the glucose which is formed is estimated by Fehling's process. A too weak acid should not be applied, nor, also, a stronger, as both are, according to the author, equally injurious to the accuracy of the results.

On Diamonds.—M. F. Rambosson.—This paper, an abstract of a printed book just published, is accompanied by an engraving representing the most celebrated of these precious stones. No mention is, however, made of the largest diamond ever yet found, which once belonged to the Rajah of Mattan, Borneo, but is now in the possession of the Netherlands' Government; this jewel, as yet uncut, however, has a flaw (a very common thing for large diamonds—for instance, the Koh-i-noor), which very materially impairs its value. This stone weighs 367 carats (upwards of 3 ozs. troy), and is egg-shaped.

Bromoform, Bromal, and Iodal compared with Chloroform and Chloral.—Dr. Rabuteau.—This paper is the record of some experiments made with these substances to test their anæsthetic value.

Cosmos, February 12, 1870.

Imperial Observatory at Paris.—By the same decree which relieves M. Le Verrier from his functions as Director of the Observatory, the provisional management and chief control of that establishment is placed in the hands of a committee of three gentlemen—viz., Vice-Admiral Penhoat; M. Combes, Member of the Institute; and M. Balard, Inspector-General of Superior Public Instruction.

Explosion of a Dynamite Manufactory.—This took place at Dunwald, near Cologne, a few days ago. The quantity of material exploded was only about 100 kilos.; but the destruction of life and property for a great distance around the spot was such as could hardly have been affected by thirty times as much gunpowder.

Dangers of Arsenical Green Pigments.—The Prefect of Police of the Seine (Paris and environs) has very properly issued a notice calling attention to the great danger attending the use of these pigments for imparting colours to the edges of books and various articles of stationery, to which these, specifically, very heavy materials are merely fixed, either by thin glue-water or gum. It is a well-known fact, the police notice says, that, even when mixed with linseed oil, these pigments are liable to become loose and pulverulent (unless peculiar precautions be taken); and they are altogether unsuitable for the purposes just named, since they dust off, and thus may be inhaled and cause derangements of health. The manufacturers of the articles alluded to are, if they continue this practice after this day, amenable to legal proceedings, correctionally as well as *en matière civile* (liable for action for damages).

February 19, 1870.

University of Heidelberg.—This, the most ancient of Germany except the Universities of Prague and Vienna, was founded in 1386, and has always been a first-rate establishment and of high standing in physical science. Helmholtz, Bunsen, Kirchhoff, Hofmeister and others have been and are among the bright gems of this scientific institution, which has a teaching staff of 80 men and an average number of from 400 to 600 students.

Rendering Tissues Waterproof (Impermeables).—V. Meunier.—1 kilo. of alum is dissolved in 32 kilos. of water, and 1 kilo. of acetate of lead is dissolved in the same

[Eng'l's Edition, Vol. XXI., No. 535, pages 94, 95.]

quantity (separately) of water. The two liquids having been mixed, there is, of course, precipitated sulphate of lead; as soon as this is deposited, the clear liquid is decanted, and the fabric which it is desired to render waterproof is thoroughly steeped in this fluid, and next dried by being hung up in open air.

Moniteur Scientifique, No. 316, February 15, 1870.

This number contains the following original papers and memoirs pertaining to chemistry:—

Peat from Avigliana, near Turin, Italy.—Dr. Fino.—Close to the Mont Cenis railway tunnel, in the valley of Susa, an enormous deposit of peat is found which, since fuel of any kind for industrial purposes is scarce all over the Italian soil, is largely used. The authors have analysed four different samples of this fuel, viz.:—The top layer, or light peat, containing, in 100 parts—Water (driven off at 100°), 44·19; volatile combustible matter, 36·44; coke, 16·44; ash, 2.93. Middle layer—Water, 38·10; volatile combustible matter, 36·09; coke, 20·89; ash, 4·92. Lower layer, compact black peat—Water, 32·41; volatile combustible matter, 36·23; coke, 21·22; ash, 10·14. Artificially-compressed very hard black peat—Water, 26·89; volatile combustible matter, 38·38; coke, 22·41; ash, 12·32. The average composition of the ash of these peats (containing, on average, after drying, 11·37 per cent thereof) is, in 100 parts—Silica and clay insoluble in HCl, 37·61; silica soluble in HCl, 0·85; protoxide of iron, 5·30; peroxide of iron, 10·22; alumina, 7·0; lime, 24·61; magnesia, 1·40; sulphuric acid, 3·04; traces of HCl, KO, NaO, and loss, 0·61; carbonic acid 0·36. The utilisable calorific value of sample 1. in wet state, is 1836; No. 2, 2172; No. 3, 2391; No. 4, 2515.

Mineral Magnesian Water from Bertinaro.—M. F. Sestini.—When recently taken from the spring, this water is perfectly limpid, and keeps so in well-corked bottles. When exposed for some time to the air, a white sediment is deposited; taste, bitter saline; exhibits a slight hydrosulphuric odour; does not affect litmus paper, but reddens turmeric paper slightly. 1 litre of the water contains—Chloride of magnesium, 1·71 grms.; chloride of sodium, 7·027; chloride of potassium, a trace; sulphate of soda, 0·368; sulphate of lime, 0·639; bicarbonate of lime, 1·83; alumina, ferrous oxide, and phosphoric acid, 0·016; silica, 0·012; organic matter and ammonia, 0·746;—total, 12·348 grms.

Ammonia Gunpowder.—M. A. Jonglet.—The owners of the Nora-Gyttorp Powder Mills, Sweden, have brought out a new kind of powder, which contains, it appears, a mixture of nitrate of ammonia and nitrate of potassa (with what other substances is not said). This material is, according to some accounts, a more powerful explosive than nitroglycerine, and cannot be ignited, or made to explode, but by the impact of a blow, or a falling weight, or by the detonation of a small cartridge containing common gunpowder. Experiments made at a military establishment at Berlin with this powder have proved that, while ordinary gunpowder, gun-cotton, nitroglycerine, and dynamite take fire the moment flame is approached, this powder did not do so. As regards the effect of the impact of a blow of a falling weight (the same, of course, in each case), ordinary gunpowder requires for explosion that the weight falls from a height of between 4 and 5 ft.; nitroglycerine, 1½ ft.; dynamite, 2¾ ft.; and ammonia gunpowder, between 12 and 15 ft. A sample having been sent to France from Berlin did not, the author says, confirm the high opinion this substance is thought worthy of in Prussia.

Waterproofing Paper.—M. A. Jonglet.—The solution of oxide of copper in ammonia acts, as is well known, as an energetic solvent upon cellulose; this property is made use of to waterproof paper in the following manner:—A tank is made to contain the solution just alluded to, and the paper is rapidly passed just over and in contact with the surface of the liquid, by means of properly-placed rollers moving with speed. The paper, on leaving, is pressed between two cylinders, and next dried by means of so-called drying cylinders, similar to those in use in paper mills. The short contact of the felty paper tissue with the liquid gives rise to just sufficient solution of cellulose to form an impermeable varnish.

Bulletin de l'Académie Impériale des Sciences de St. Petersbourg, Vol. xiv., No. 3, 1869.

The only paper relating to chemistry in this number is a lengthy one:—

Chlorinated Derivatives of Toluol.—Drs. F. Beilstein and A. Kuhlberg.—The authors have divided their memoir into the following sections:—Isomeric tetrachlorotoluols—

$CH_6\,Cl_4.CH_3$, $C_6H_2Cl_2.CH_2Cl$, $C_6H_3Cl_2.CHCl_2$, and $C_6H_4Cl.CCl_3$;

isomeric pentachlorotoluols—

$C_6Cl_5.CH_3$, $C_6HCl_4.CH_2Cl$, $C_6H_2Cl_2.CHCl_2$, and $C_6H_3Cl_2.CCl_3$;

isomeric hexachlorotoluols—

$C_6Cl_5.CH_2Cl$, $C_6HCl_4.CHCl_2$, and $C_6H_2Cl_2.CCl_3$;

isomeric heptachlorotoluols—

$C_6Cl_5.CHCl_2$ and $C_6HCl_4.CCl_3.C_6Cl_5.CCl_3 = C_7Cl_8$.

There is added to this memoir an extensive tabulated review of all the compounds treated of, exhibiting their boiling-point, specific gravity, percentage composition, crystalline shape, melting-point of the solid substances and formulæ.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 20, 1869.

This number opens with a beautifully-executed and very good photographic likeness of the late lamented Thomas Graham, represented as he was known to us in the later days of his life. A full biography of the deceased, from the hand of his friend Dr. A. W. Hofmann, forms a conspicuous and valuable portion of this number, which contains the following original papers and communications:—

Various Reactions Exhibited by the Salts of Oxide of Copper (Black Oxide) when Cyanogen Compounds are Present.—Ed. Schaer.—This very lengthy paper is reserved for future communication in full.

Synthesis of Aromatic Acids.—Th. Zincke.—Referring to the observation of Dr. Wislicenus, that minutely-divided silver is one of the best means for the concatenation (verkettung) of carbon atoms, the author imagined that this might be also useful for the synthesis of aromatic acids. He describes, at very great length, his experiments, beginning with a toluolic acid, phenylo-acetic acid; but, instead of applying silver, use has been made of very minutely-divided copper. The ethyl-ether of the acid just alluded to was heated, along with bromide of benzol and copper, to from 180° to 200°, in a sealed tube. After a lengthy and complicated process of purifying, a sufficient quantity of pure material was obtained to test its properties, which are—A solid crystalline body, fusing at 76°, subliming at a higher temperature, without decomposition, and difficultly soluble in cold, but more readily so in hot, water. The analysis of the silver-salt and the products of oxidation by means of chromic acid, yielding carbonic acid and benzoic acid, prove the perfect identity of the substance as a tolnylic acid. Synthesis of phenyl-propionic acid.—The author thought that it might be possible to withdraw from monochloro-acetic acid and chloride of benzyl, the chlorine, by means of copper or silver, and to obtain an acid, $C_6H_5.CH_2CH_2COHO$—that is to say, β phenyl-propionic acid; but the results of a series of experiments did not confirm this view; and the body chiefly produced is a substance insoluble in alcohol, whether cold or hot, difficultly soluble in ether, and slightly better soluble in benzol, chloroform, and sulphide of car-

bon, from all of which solutions it is only obtainable as an amorphous, brittle resin, exhibiting, even in its dilute solutions, a bluish fluorescence similar to that exhibited by solutions of quinine. Energetic oxidising substances are, even at boiling heat, without any action upon this substance, which yielded, by elementary organic analysis, in 100 parts —C. 92·98; H, 6·72; formula, C_7H_6. When chloride of benzyl is diluted with twice its bulk of any hydrocarbon boiling at 130°, and then treated as above described, an aromatic oily substance is obtained, which the author reserves for further investigation.

Chlorocarbonate and Carbaminate of Phenol.—Th. Kempf.—Referring to his former researches on this subject, the author states that he has obtained a compound—

$$C_7H_7NO_2 = CO \begin{cases} H_2N \\ OC_6H_5 \end{cases}$$

fusing at 141°; soluble in water, alcohol, and ether; and yielding, on evaporation of these solutions, a crystalline substance; when heated to about 150° with a saturated solution of ammonia in water, phenol is formed, and urea.

Estimation of the Quantity of Sulphide of Carbon in Coal Gas.—A. Vogel.—The author first alludes to the great perfection the purifying process of coal gas has attained (at least, abroad, where gas-works are under very severe inspection, and especially so in the country this author hails from—viz., Bavaria), so that coal gas may be made to pass for several consecutive hours through a solution of a lead-salt without affecting it in the least. As to the presence of sulphide of carbon (which, by the bye, the author remarks, owes its formation very much to defective care, in respect of the temperature applied to the retorts, as well as to unsuitable selection of the qualities of coal), it can only be present in small quantity, and therefore its detection, as well as its estimation, become rather more difficult. The plan suggested and experimentally tested is the following, based upon the simple fact that, when pure metallic copper is in contact with gas containing sulphide of carbon, sulphuret of copper is formed:—Coal gas, purposely purified from every trace even of sulphuretted hydrogen, was caused to pass over bright metallic copper for several hours. The surface of the metal having assumed an iridescent hue, the copper was washed with dilute nitric acid; and a solution of a salt of barium having been added to this acid solution, a precipitate of sulphate of baryta was obtained after some hours' standing. It is, of course, absolutely required to use pure reagents, and insure the freedom of the copper from any sulphur.

Constitution of Isatine, Isatinic Acid, and Indol.—Aug. Kekulé.—This paper contains a lengthy hypothetical discussion on this subject in reference to the researches of MM. Baeyer and Emmerling and the author's own.

From the *procès verbal* of the annual general meeting of this Society, we learn that it now numbers 408 members—viz., 137 home and 271 foreign—including a great many Germans resident beyond the limits of the North Germanic confederation. It has extended its correspondents to the chief countries of Europe and America, and possesses an already valuable library, while its financial position is all that can be desired.

Revue des Cours Scientifiques de la France et de l'Etranger, February 19, 1870.

This number contains an excellent paper—

Lecture on the Mechanical Forces.—M. A. Cazin; but no papers at all relating to chemistry.

The American Journal of Science and Arts, January, 1870.

This number contains the following original papers and memoirs relating to chemistry and allied sciences:—

Relation between the Intensity of Light produced from the Combustion of Illuminating-Gas and the Volume of Gas Consumed.—B. Silliman.—This lengthy paper contains valuable information on this subject, and a detailed description of a series of experiments made with a view to prove, among other matters, also this theorem—that the intensity of gas-flames (*i.e.*, illuminating power) increases, within the ordinary limits of consumption, as the square of the volume of the gas consumed. The chief point of interest for the consumer of gas to be deduced from the data here presented is that, where it is important to obtain a maximum of economical effect from the consumption of a given volume of illuminating-gas, this result is best obtained by the use of burners of ample flow.

Principles of Molecular and Cosmical Physics.—W. A. Norton.—A lengthy philosophical essay.

New Method of Separating Tin from Arsenic, Antimony, and Molybdenum.—F. Wigglesworth Clarke.—Reserved for full reprint at a future date.

Contributions to the Chemistry of Common Salt, with particular Reference to Our Home Resources.—C. A. Goessmann.

Account of a Fall of Meteoric Stones near Danville, Ala., with an Analysis of the Same.—J. Lawrence Smith.—This stone fell on Friday, November 27th, 1868, at about 5 o'clock p.m., at Danville (about lat. 34° 30' N., and long., 87° W. of Greenwich). The iron, separated with great care from the pulverised meteorite, constitutes 3·092 per cent; and, on analysis, furnished—Iron, 89·513; nickel, 9·050; cobalt, 0·521; copper, a minute quantity; phosphorus, 0·019; sulphur, 0·105. The sulphide of iron, detached very carefully from the mass, gave—Iron, 6·11; sulphur, 39·56. The stony minerals, freed as much as possible from iron and pyrites, contained—Portion soluble in acid, 60·88; insoluble, 39·12. The latter, disintegrated and analysed, gave, in 100 parts—Silica, 50·08; alumina, 4·11; protoxide of iron, 19·85; magnesia, 20·14; lime, 3·90. The analysis of the soluble portion, owing to the unavoidable presence of a little iron and pyrites, furnished results, on analysis, that showed it to be mostly olivine. The soluble and insoluble matter as a whole (freed from pyrites and nickeliferous iron) gave, in 100 parts—Silica, 45·93; protoxide of iron, 23·64; magnesia, 26·52; alumina, 1·73; lime, 2·31; soda, 0·51; potassa, 0·64; sulphur, 1·01; and small quantities (not estimated) of oxides of manganese and chrome, phosphorus, and lithia; the latter detected by means of the spectroscope.

Annales des Mines, No. 5, 1869.

This number contains:—

Critical and Theoretico-Practical Examination of the Heaton Process.—M. L. Gruner.

Some Newly-Discovered and Proposed Processes for the Manufacture of Pig-Iron, Wrought-Iron, and Steel.—M. L. Gruner.

Researches on the Use which can be made of the Offal and Residues of Manufacturing Processes for Agricultural Purposes.—MM. E. Nivoit and E. Létrange.—We regret that we can only quote the sectional titles of this very interesting and lengthy memoir, which is filled with valuable information and a large number of chemical analyses. Residues from glue works; residues from beet-root sugar works; residues from the retting and peeling of flax; residues from breweries; gas-works residues and refuse; refuse from wool; residues and refuse from tanyards; tallow-melting refuse; saw-dust and wood ashes; coal ash; some peculiar mineral ash (*cendres minérales*) from the Ardennes, and their application to mixing with liquid manure. In many instances, full directions have been given for the proper analysis and quantitative estimation of the materials spoken of.

Boring of Shafts by Kind-Chandron's Method at Escarpelle.—M. J. De Boisset.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No 1, 1870.

This number contains the following original papers and memoirs:—

A Base Isomeric with Hydrocyanide of Ammonia (Cyanwasserstoff-Ammonia.)—H. Wichelhaus.—When orthoformic acid ether and acetamide are heated in a sealed tube for some hours to 180°, there is formed along with alcohol a white-coloured crystalline substance, the origin of which is explained by the following formula:—

$$CH(OC_2H_5)_3+2C_2H_3O{\cdot}NH_2=3C_2H_6O+CH\left\{\begin{matrix}NH(C_2H_3O)\\N(C_2H_3O)\end{matrix}\right.$$

This substance is methenyl-diacetyl-diamine. Another product of this reaction is a substance the platinum salt of which is—

$$CN_2H_{11}2HCl,PtCl_4;$$

while the base itself is CN_2H_4, termed by the author amidomethenylimide, and found to be isomeric with hydrocyanide of ammonia.

Terchloride of Iodine.—Jul. Philipp—The terchloride of iodine does not behave with reagents as the other terchlorides do; treated with alkalies, it does not yield iodous acid (*jodige säure*), but iodic acid, while iodine is set free. This, according to the author, is due to the fact that ICl_3 is not a simple molecule, but a juxtapositiou of ICl and Cl_2; and this is proved by the behaviour of the terchloride of iodine with reagents. These reactions are described at very great length, but space forbids to enter into more details.

Manufacture of Sulphuric Acid.—A.W. Hofmann.—The use of the nitric acid in the manufacture of sulphuric acid is to transfer the oxygen of the air on to the sulphurous acid; and, theoretically, therefore, a given quantity of nitric acid ought to convert an unlimited amount of sulphurous into sulphuric acid. That this is not obtained in practice can hardly be wondered at, since no manufacturing processes can be conducted absolutely without loss; but the loss of nitric acid in the manufacture of sulphuric acid, even when proper care is taken to ensure good working of the chambers, is so large that the inference is quite justifiable that there are peculiar chemical reactions at play. The study of these reactions has occupied the author, who states that, although he has not solved the problem entirely, he has obtained results worth communicating. When sulphurous acid is caused to pass into nitric acid which contains some sulphuric acid (sp. gr., 1·676 to 1·714), the nitric acid is converted into compounds which form, along with the sulphuric acid present, the so-called chamber crystals, without any perceptible formation of protoxide of nitrogen; but, when the nitric acid is impregnated with a sulphuric acid (sp. gr., 1·532), and the experiment just alluded to repeated, there is formed a considerable quantity of nitrogen, which is, of course, quite as injurious to the process as the presence and formation of protoxide of nitrogen. The explanation of this phenomenon is the insufficient strength of the sulphuric acid to form, in combination with the higher degrees of oxidation of nitrogen, the so-called chamber crystals. This having been ascertained, the author applied his knowledge of these facts in the following manner on the large scale:—The quantity of steam admitted to the first chamber (the so-called Tambour) was so regulated as to produce acid only at 60° Beaumé (sp. gr., 1·714 = 143° Twaddle), with the striking result, fully confirming the laboratory experiment, that a far smaller quantity of nitric acid was required for the same production of sulphuric acid. The author adds, that if, by accident, the strength of the acid in the aforesaid chamber should fall below the sp. gr. just alluded to, it can be easily brought up to that strength by the addition of acid of 66° Beaumé (sp. gr., 1·847) = 169 Twaddle. By this contrivance, it is possible to manufacture sulphuric acid with a consumption of only 1 lb. of nitric acid for 100 lbs. of sulphur burnt.

Derivatives from Guanidine.—F. Tiemann.—The author describes—Naphthyldiphenyl-guanidine—

$$C_{23}H_{19}N_3=\left\{\begin{matrix}^{IV}\\C\\C_{10}H_7\\(C_6H_5)_2\\H_2\end{matrix}\right\}N_3;$$

naphthyltolylphenyl-guanidine—

$$C_{24}H_{21}N_3=\left\{\begin{matrix}^{IV}\\C\\C_{10}H_7\\C_7H_7\\C_6H_5\\H_2\end{matrix}\right\}N_3;$$

diacetolylendiamine—

$$C_{11}H_{14}N_2O_2=\left\{\begin{matrix}C_7H_6\\(C_2H_3O)_2\\H_2\end{matrix}\right\}N_2;$$

and treats, at great length, of the preparation and complicated reactions by which these substances are obtained.

Ethyl Combinations of Thallium.—C. Hansen.—Thallium-diethyl-chloride, $Tl(C_2H_5)_2Cl$, a solid substance, soluble in boiling water, ether, and alcohol, is affected by light similarly to chloride of silver; slowly heated to 225°, it does not melt, but is charred; rapidly exposure to heat causes its instantaneous decomposition, accompanied by explosion, yielding a mixture of ethylen, ethylic hydride, and chloride of thallium; this decomposition ensues, therefore, according to the formula $Tl(C_2H_5)_2Cl = TlCl + C_2H_4 + C_2H_6$. Sulphethallium-diethyl, $(Tl[C_2H_5]_2)SO_4$, also a solid substance, crystallising in a foliated mass, soluble in water, ether, and alcohol. Nitro-thallium-diethyl, $Tl(C_2H_5)_2NO_3$, a solid body, very readily decomposable by heat.

Silico-Propionic Acid.—C. Friedel and A. Ladenburg.—A lengthy and exhaustive monograph.

Contribution to Explain Chemical Phenomena according to Mechanical Principles.—Dr. J.W. Gunning.

Appendix to the Researches on the Guaiacum Copper Reaction.—Ed. Schaer.—This is a supplementary part to the author's researches on this subject as detailed in the foregoing number of this periodical, but not suitable for abstraction.

Regressive Formations (Regressiv Bildungen) by Tri-Substituted Guanidines.—V. Merz and W. Weith.

Diamines Derived from α and β Dinitronaphthalines.—A. de Aguiar.—This paper, and the immediately foregoing, are too lengthy and too full of formulæ and diagrams to admit of any useful abstraction.

Researches on Xantho-Cobalt, Roseo-Cobalt, and Purpureo-Cobalt.—W. Gibbs.—The author states that, as an addition to his researches on xantho-cobalt, he has discovered the roseo- and purpureo-cobalt; the chloride of xantho-cobalt, $CO_2.(NO_2)_4.Cl+4NaCl$; chloride of purpureo-cobalt, $10NH_3.CO_2.Cl_6+4NaNO_3$. The memoir is an accumulation of formulæ, some of which are so lengthy that they occupy from two to four lines in print. The paper does not state anything about the origin or preparation of the substances, named along with several others.

Lecture Experiments.—J. Schoras.—(1.) *On Some Peculiar Actions of the Sun's Rays.*—When it is desired to prove the reducing action of oxalic acid upon metallic chlorides, it is a well-known experiment to boil a solution of chloride of gold to which oxalic acid solution has been previously added. The lecturer quotes, at the same time, another instance of this kind—viz., that a solution of chloride of mercury (corrosive sublimate), when treated in the same manner, is reduced to subchloride (calomel). When, during the lecture, this experiment is made too hurriedly, for the

sake of saving time, the only appearance seen is the feeble turbidity produced by the separation of a mere cloud of calomel; and, even if the boiling is continued for some time, it is readily seen that this reaction is not quite complete. When, however, a solution of perchloride of mercury is, after the addition of oxalic acid, exposed to the action of direct sunlight, the copious precipitation of calomel ensues, after a few minutes' exposure, in the shape of brilliant mother-of-pearl-like scales, which, illuminated by the direct sunlight they are formed by, give rise to a beautiful phenomenon. If this sediment is collected, and dried at 110°, it will be found, on analysis, to contain 15·2 per cent of chlorine, thus proving it to be calomel. This experiment, and the undermentioned, can however, only be tried in our latitude when the sun is at its zenith, in July. When a solution of Berlin blue in oxalic acid is exposed to the direct rays of the sun, a sudden precipitation of Berlin blue ensues, and, instead of a deep-coloured, almost non-transparent fluid, a perfectly clear colourless liquid is exhibited. It is a well-known fact that solutions of the persalts of iron and uranium, to which oxalic acid is added, are, on being exposed to direct sunlight, converted to solutions of the protoxides of the metals, while carbonic acid is given off. The perchlorides answer best for experiments; a solution of perchloride of iron, to which tartaric acid has been added, is acted upon in a manner which is not quite explained. Such a solution is used in photography, in the so-called carbon process. A collodion plate, impregnated with the iron solution referred to, and dried in the dark, obtains, on exposure to light, the property of retaining, energetically, at the portions affected by the light, finely-divided substances—as, for instance, powdered black-lead, English red, finely-divided metals, and metallic oxides. The quantity of the powders thus adhering depends upon the greater or lesser intensity of the light which has fallen on it; and it is this condition which defines the various depths of hues and shades, and renders the stereometrical representation of the object possible. Photographers say that the action of the light has rendered the salt hygroscopic, and that this property causes the adhesion of the pulverulent substances. Whatever the action may be, the author states that a reduction process is in play. A solution of chloride of iron, to which tartaric acid had been previously added, and the colour of which was deep yellow, became, when exposed to direct sunlight, quite colourless; an evident proof that reduction had taken place. When a solution of peroxide of iron in tartaric acid is exposed to direct sunlight, a copious sediment of a crystalline yellowish green-coloured substance is thrown down. Since reduction takes place here on the one hand, oxidation must take place, of necessity, on the other; but it is not accompanied by any evolution of gas. The author reserves further study and experiments on this subject, which, as he very properly observes, may throw light upon many processes going on in animal and vegetable life. (2) *Peculiar Phenomena of Colouration Exhibited by Some of the Platino-Cyanides.*—Gmelin was the first discoverer of potassium platino-cyanide; MM. Quadrat and Schafarik obtained similar compounds afterwards. We owe to Dr. Martius a valuable and exhaustive work on these substances and their composition. It is well-known that many of these salts are remarkable for a strong di- and tri-chroism; and this induced the author of this paper, while preparing a series of these salts, to make some very curious observations thereon, which are described as follows:—The calcium and magnesium salt of this series lose their water of crystallisation completely at a comparatively low temperature, and take it up again on cooling with great ease and rapidity. The anhydrous salts are white—the hydrated are coloured; therefore, paper and other suitable materials impregnated with solutions of these salts, become coloured. But a slight elevation of temperature is sufficient to decolourise them; and, on cooling, the colour reappears, in consequence of the more or less ease and rapidity wherewith the water of crystallisation is taken up. A slip of paper impregnated with a solution of magnesium platino-cyanide, exhibits, after drying, a beautifully bright red colour. A slight elevation of temperature is sufficient to render the salt anhydrous, and to temporarily destroy the colour entirely, which, however, reappears on cooling; while the re-taking up of the water may be aided by breathing over the paper. A slip of paper impregnated with a solution of calcium platino-cyanide exhibits, after drying, a bright canary-yellow colour; on being warmed, dehydration of the salt takes place, and, consequently, its complete decolouration; removal from the source of heat, accompanied by gentle breathing over the paper, is sufficient to restore the colour. When these experiments are made at night-time, magnesium light should be employed to render the true colours (especially the yellow) properly visible. The barium salt is also yellow-coloured, but is not so sensitive for the purpose as the calcium salt. When a mixture of the solution of the barium salt along with the potassium salt of this series is taken for the purpose of impregnating paper, that material exhibits, after drying, an unsightly yellow colour, which has the property of changing, by gently heating, from yellow to orange and red; and if the heat be increased, the original colour returns. While cooling, the piece of paper impregnated with the salt exhibits the phenomenon of passing through the same series of shades of different colours already alluded to—viz., yellow, orange, red, and again whitish yellow, the original colour. The lithium platino-cyanide is deliquescent, and hence unsuited for any experiments of a similar nature; the ammonium salt exhibits, while being evaporated to dryness on a porcelain basin, most curious brown-red colourations. The author suggests that if, while experimenting with these impregnated slips of paper in a lecture-room, any of them become ignited and burn to ash, this should be taken upon the feather of a quill, and immediately removed to a jar containing a mixture of oxygen and hydrogen (in the proportions to form water), and thus show the action of the spongy platinum left in the ash. The slips of paper impregnated with the calcium salt may, after having been previously decoloured by the application of heat, be very suitably applied for the detection of the least trace of moisture, since that has the effect of at once restoring the yellow colour. The author particularly points out that, since all the salts here spoken of are most violent poisons, they should not be used, or experimented with, but by parties who can be trusted with such matters; fortunately, also, the preparation is an expensive operation, as well as one requiring great skill and more knowledge than is common with those who usually undertake the preparation of chemical substances for sale as amusing toys.

Bulletin de la Société Chimique de Paris, January, 1870.

From the *procès verbaux* of the meetings of the Society we learn that M. J. Gautier gave a brief communication on the following questions:—Is the temperature at which two gases combine invariable? What influence is exerted by the products of their mutual reaction? What influence is exerted by any impurities purposely added? The author states that he is engaged in researches to answer these questions, and gave the following account of the results hitherto obtained:—A mixture of 2 volumes of hydrogen and 1 of oxygen having been made, this was exposed to incipient red heat, when it was found that union of the two gases takes place without being attended by any explosion. When heated by means of a Bunsen gas burner, union takes place instantaneously; and at an intermediate temperature between the first and last-named, union takes place rapidly, but without any explosion. Oxide of carbon unites with oxygen below red heat visible by daylight; chlorine and hydrogen, placed in absolutely opaque and sealed tubes, begin to form chlorhydric acid at 190°, and at 200° the combination becomes rapid. M. J. Friedel communicates that he has obtained oxide of amyl by heating, to 200°, amylic alcohol with one-tenth of its weight of iodide of amyl. The products of the reaction are—Water, amylen, amylic alcohol (mixed with some iodide of amyl and oxide of amyl; the

latter in quantity of about one-third of the alcohol employed. Dr. Prinvault states that, when he made bromine act upon protochloride of phosphorus, a brownish coloured oil was obtained, boiling at 75°; this liquid was found to consist of a fluid, $PBr_3+3ClBr$, and a solid substance deposited on cooling in prismatic crystals, $PBr_3+2ClBr$. When protochloride of phosphorus is made to act on bromine, a solid substance, fusing at 45°, and crystallising in oblique prisms, is obtained; formula, PCl_3Br_4. Heat decomposes these, yielding the protochloride and PCl_3Br_6.

The following papers and memoirs were read or deposited:—

Relation Existing between the Variation of the Crystalline Shape of Alum and the Menstruum it is Crystallised from.—E. Janettaz.—After referring to the labours of MM. Weber and Bendaut Lévy on this subject, the author describes a series of experiments made with the view of eliciting answers to the following questions:—Does the menstruum affect the composition of the crystals of alum? Are the isomorphus alums influenced in the same way by identical conditions? Is the action of acids isomorphous with hydrochloric acid the same? Supposing an alum to have been modified by hydrochloric acid, to be next dissolved by water, does the hemiedric condition remain? Is the complex form exhibited by these substances the result of all the bodies simultaneously in solution with them? Is any free acid required for the purpose of imparting to these substances a peculiar crystalline form? The lengthy memoir is rather a crystallographical essay.

Researches on the Action of Oxychloride of Carbon upon the Carbides of Hydrogen.—Dr. Berthelot.—In the introduction to this memoir, the author says that, while experimenting with oxychloride of carbon, he found, to his surprise, that this gas does not possess the chemical activity commonly attributed to it of late. This discovery induced him to repeat Haruitzky's experiments on the synthesis of organic acids, by causing the oxychloride of carbon to react upon carbides of hydrogen. The author states that, notwithstanding every exertion made by him, he did not succeed in obtaining any of these substances; and relates, at great length, what reactions, if any at all did take place, between the oxychloride and marsh-gas; acetylen and benzol; oxychloride, with excess of chlorine; nascent oxychloride and an impure oxychloride; and the same hydrocarbides.

History of Oxychloride of Carbon.—Dr. Berthelot.—The most salient part of this paper is that, when oxychloride of potassa is placed in contact with slightly-damped bicarbonate of potassa, the volume of the gas increases three-fold, and is still completely absorbed by caustic potassa—

$$C_2O_2Cl_2+2(C_2O_4.KO.HO)=3C_2O_4+2KCl+H_2O_2.$$

Analysis of Mixtures of Gases Containing Oxychloride of Carbon.—Dr. Berthelot.—Suppose a gas mixture to contain chlorine, oxychloride of carbon, oxide of carbon, oxygen, and nitrogen. Shake the mixture first with some mercury, to remove the chlorine; caustic potassa solution removes oxychloride; pyrogallate of potassa removes oxygen; protochloride of copper removes oxide of carbon. Let the mixture contain—Oxychloride of carbon, hydrochloric acid, carbonic acid, oxide of carbon or carburetted hydrogens, oxygen, and nitrogen. Mercury is applied for the removal of chlorine. One single drop of water dissolves and takes the hydrochloric acid, without affecting either the oxychloride or carbonic acid, one single drop of absolute alcohol first dissolves the oxychloride, converting it into an ether which, along with any vapour of alcohol, is removed by a drop of concentrated sulphuric acid The residue is treated by a single drop of a concentrated solution of caustic potassa, which takes up carbonic acid; the oxygen is removed by pyrogallate of potassa, the hydrocarbides by bromine, and the oxide of carbon by protochloride of copper.

On Chloride of Acetylen, and on the Synthesis of Julin's Chloride.—Drs. Berthelot and Jungfleisch.

Action of Hydrate of Potassa upon the Sulphuric Acid Derivatives of Hydrocarbons.—Dr. Berthelot.

Synthesis of Acetic Acid from Acetylen.—Dr. Berthelot.—These three papers have appeared in a condensed state in the *Comptes Rendus*, and were noticed by us.

Products of the Condensation of Valeric Aldehyde.—J. Riban.—The author states that his chief object is to say that, while M. Borodine has preceded him in the publishing of results obtained on this subject (see Chemical News, vol. xx., p. 286; *Am. Repr., Feb.* 1870, *p.* 104, quoted by J. Riban), he reserves to himself the right of giving his experiments, as made at a date anterior to M. Borodine's, whose researches he confirms as correct.

Salicilonitrile.—E. Grimaux.—A continuation of a former paper.

On Phenate of Isopropyl and some Bromated Derivatives.—R D. Silva.—Phenate of isopropyl, $C_6H_5(CH_3-CH-CH_3)O$, is a colourless, somewhat viscous liquid, smelling like essence of geranium; boils at 176°; sp. gr. at 0°, 0·958; refraction index, 1·5124; vapour density, 4·73. Monobromated isopropyl, $C_6H_4Br(CH_3-CH-CH_3)O$, a colourless, rather viscous liquid, insoluble in water, soluble in alcohol and ether, and boiling at 236°; sp. gr. at 0°, 1·981. Perbromated phenate of isopropyl, a solid substance fusing at 95°.

Bromotoluen and Paratoluidine.—O. Wallach.—The main object of this paper is a rectification of errors committed, according to the authors, at least, by M. Rosenstiehl, who states that the author had mistaken a mixture of pseudotoluidine and toluidine for a bromotoluen.

Letter from M. Kraut to the Editor of the "Bulletin," Requesting Correction of some Abstracts from M. Kraut's Paper on Salicylic Compounds.—A brief notice, the greater portion of which is occupied with formulæ—*e. g.*, trisalicylosalicylic acid—

$$H.O.C_6H_4.CO.OC_6H_4CO.O.C_6H_4CO.O.C_6H_4.CO.O.H$$

Annales du Genie Civil, January, 1870.

This periodical rarely contains original papers on chemistry and allied sciences; but this number contains a paper on—

Soap and Soap Making.—L. Droux.—Divided into several sections. Introduction; from what time, or period, does the making of soap date? soap was known to the ancients; soap making at Marseilles in the 17th century; artificially-made soda, vegetable oils, and oleic acid; distribution of the soap-works over Europe; soft soap unknown and never used in southern countries; legislative enactments, as regards soap and the fiscal duties thereon; statistical review of the importance of the soap manufacture in France, the United Kingdom, and other European countries. This is simply the skeleton of the contents of this, in many respects, very important paper. Soap, the author proves, was known to the ancients at a very remote period, but its manufacture was not generally well understood. It appears we are in Europe indebted to the Saracens for the re-discovery of the manufacture of soap, as much as for the discovery of the manufacture of paper, sugar refining, and other industrial arts.

Zeitschrift für Chemie von Beilstein, No. 3, 1870.

This number contains the following original papers:—

Formation of Ozone During Active Combustion.—O. Loew.—After referring to the well-known instances of the formation of ozone during slow combustion and oxidation, the author gives the opinion that every act of oxidation, whether slow or more rapid, is accompanied by the formation of ozone just previous to the combination between the substance to be oxidised and the oxygen converted into

a state of great activity taking place. The following experiment is described to prove this dictum:—A current of air is blown through a rather wide glass tube towards the flame of a Bunsen gas burner; and opposite the end of the tube, which is directed towards the flame, a suitably-sized beaker glass is held; and after a few seconds, the blowing is discontinued, and the beaker-glass simultaneously covered with a glass plate. When the air contained in the beaker-glass is tested, it will be found to emit the peculiar odour of ozone, to blue guaiacum paper, and to separate iodine from iodide of potassium. The formation of ozone is greatest when the current of air is so strong as nearly to cause the extinguishing of the flame. The experiment succeeds with every other kind of flame, provided care be taken so to regulate the current of air as to exclude the presence of intermediate products of combustion, as, for instance, vapours of partly-consumed alcohol, if a spirit-flame be used. The author draws from his researches the following conclusions:—(1) Oxygen is first converted into ozone in every case where active combustion takes place. (2) Far more ozone is formed than is required for the keeping up of the process of complete combustion and oxidation of the oxidisable material. This surplus of ozone is, in all ordinary cases of combustion, destroyed, partly by the high temperature, and partly by the rush of cold air, and draught thereby caused, attending the combustion.

Dissociation of Fluid Sulphuric Acid, and on a General Method of Estimation of the Degree of Dissociation of a Fluid Compound.—L. Pfaundler.—The author first briefly refers to W. Dittmar's paper on this subject, and next gives a lengthy tabulated form, exhibiting the results of his researches on the dissociation of sulphuric acid, finishing his paper with a number of algebraical formulæ suitable for the calculation of the degree of dissociation of any fluid compound.

Regressive Formations (Regressiv Bildungen) of the Tri-Substituted Guanidines.—V. Merz and W. Weith.—It is rather to be regretted that the authors of this paper have not commenced it by giving a concise explanation of what they understand by regressive formations, which is not at all clear from the contents. Sulpho-carbanilide is decomposed (so the paper begins), by the action of heat, into triphenyl-guanidine, sulphide of carbon, and sulphuretted hydrogen. From the further contents and description of experiments, it would appear that, by regressive formation, is meant a regeneration of a substance—say, sulpho-carbanilide—while being heated, so that, instead of its entire decomposition as final result, there is found a large quantity (the authors mention even 90 per cent) of the substance unacted upon by heat. The chief illustration given of what is understood by the regressive (better, perhaps, in English, regenerative) process is rendered by the following formulæ, referring to the two reactions by which sulpho-carbanilide can be obtained from triphenyl-guanidine; the formulæ hold good also, regressively:—

$$\begin{array}{l} N<\begin{matrix}C_6H_5\\H\end{matrix} \\ | \\ C=NC_6H_5+CS_2 \\ | \\ N<\begin{matrix}H\\C_6H_5\end{matrix} \\ N<\begin{matrix}C_6H_5\\H\end{matrix} \\ | \\ C=NC_6H_5+H_2S \\ | \\ N<\begin{matrix}H\\C_6H_5\end{matrix} \end{array} = \begin{array}{l} N<\begin{matrix}C_6H_5\\H\end{matrix} \\ | \\ C=S \quad +C<\begin{matrix}S\\NC_6H_5\end{matrix} \\ | \\ N<\begin{matrix}H\\C_6H_5\end{matrix} \\ N<\begin{matrix}C_6H_5\\H\end{matrix} \\ | \\ C=S \quad +C_6H_5.NH_2 \\ | \\ N<\begin{matrix}H\\C_6H_5\end{matrix} \end{array}$$

Note on Oxalate of Silver.—F. A. Mühlhäuser.—The author says, Drs. Thudichum and Wanklyn stated some time ago, in contradiction to Gmelin, that oxalate of silver is an anhydrous salt; but, however correct the statement of the gentlemen just named may be, it is no novelty at all, having been long since mentioned in the *Annalen der Chemie* (101, 177). The author adds—It would have been of far more value to science if the parties had communicated their mode and means of correctly analysing a salt which is very readily decomposed with explosion.

Products of Condensation from Oenanthol.—Hugo Schiff.—About twenty-one years ago, says the author, Dr. Williamson found that a solution of oenanthol in four volumes of alcohol, saturated with HCl, yielded, on addition of water, oenanthic ether. The author contradicts this, stating at the same time that Dr. Williamson's oenanthol has been, in all probability, largely contaminated with oenanthic acid, since pure oenanthol, previously saturated with HCl and dissolved in alcohol, separates into two layers, distinctly exhibiting a different specific gravity. The chief product of this reaction is septenoxyethyl-chloride—

$$C_7H_{14}\begin{cases}O.C_2H_5\\Cl\end{cases}$$

a substance insoluble in water, soluble in alcohol and ether and becoming gradually decomposed, even by the addition of warm water. This substance is dissociated by distillation, yielding hydrochloric acid, ethylene, chloride of ethyl, steam, a mixture of hydrocarbons, and a couple of oxygenated compounds. The following products of fractional distillation were obtained from the residue of the first distillation, carried on to 320°:—Oenanthylen, C_7H_{14}, boiling-point, 90—100°; a fluid boiling between 245° and 260°, $C_{14}H_{26}$; boiling between 320° and 330°, $C_{14}H_{22}$; residue left at 350°, $C_{14}H_{18}$. The remainder of this paper is devoted to a lengthy discussion, accompanied by a large number of formulæ, to explain how the different substances and products of the complex reactions are derived from the original material applied for the preparations.

Sulpho-Fumaric Acid.—B. Credner.—Sulpho-fumaric acid, $COOH.CH_2.CHSO_3OH.COOH$.—The preparation and purification of this substance are described at length; the process is complicated and tedious. The pure material is a syrup-like, very sour fluid, which, by being kept over sulphuric acid, yields traces of crystalline appearance; the acid and its salts, a number of which are described, are isomeric, but not identical with sulpho-succinic acid. Sulpho fumarate of potassa, $C_4H_2K_3SO_7+H_2O$, is a crystalline mass which effloresces on exposure to air. Neutral sulpho-fumarate of lead—

$$C_4H_3Pb_3O_7S+2H_2O,$$

is a salt readily soluble in water, in aqueous solution of acetate of lead, and in free acids, and obtained by double decomposition of a potassa salt of the acid in question, can never be obtained quite free from potassa. The basic lead salt of this acid $C_4H_2Pb'_3O_7S+Pb_2O$, is a crystalline compound, rather insoluble in most menstrua.

Behaviour of Salicylic Aldehyde when it is Heated with Primary Monamides.—B. Credner.—This paper treats of the action of acetamide upon salicylic acid at an elevated temperature, resulting in the formation of a substance soluble in alcohol, yielding, on elementary organic analysis, in 100 parts:—C, 57·82, 58·56, 64·35; H, 5·80, 6·18, 5·55; N, 8·01, 7·81. After purification with alcohol, the figures obtained were—C, 65·33, 68·48, 66·20, 63·27; H, 5·81, 6·40, 5·73, 5·69; N, 8·11, 7·35. When salicylic aldehyde was heated with benzamide, a similar substance was obtained.

Comptes Rendus des Séances de l'Académie des Sciences, February 21, 1870.

This number contains the following original papers and memoirs relating to chemistry and allied sciences:—

Cause of the Electro-Capillary Currents in the Bones, Nerves, and Brain.—E. Becquerel.—A physiologico-physical treatise.

Synthesis of Aromatic Acids.—A. Wurtz.—The substance mainly described in this paper is dibenzyl-carboxylic acid, $C_{15}H_{14}O_2$, obtained by the action of sodium upon chloride of benzyl and chloroxycarbonic ether, according to the following formula:—

$$2(C_7H_7Cl)+CO\left\{\begin{matrix}Cl\\O.C_2H_5\end{matrix}\right\}+3Na=3NaCl+H+C_{14}H_{13}-CO_2.C_2H_5.$$

This acid is almost insoluble in cold water, somewhat soluble in boiling water, and very readily soluble in alcohol and ether. It is a solid substance; it fuses at 54°; at a very high temperature, it boils, and distils over without alteration. The salts of this acid crystallise with difficulty; the calcium salt yields, when submitted to dry distillation along with excess of lime, a mixture of dibenzyl and stilben.

Stability of the Normal Propylic, Butylic, and Amylic Alcohols, considered as Chemical Species (Especes Chimiques).—J. Pierre and E. Puchot.—The authors have studied chiefly—The temperature of ebullition; the specific gravity at 0°, and at various other temperatures; the index of refraction at one and the same temperature; and the action of polarised light of the substances just named. The results are given in the shape of tabulated forms.

Report on the Labours Concerning Ozone.—Aug. Houzeau.—From this very lengthy paper, we quote an almost unknown fact—viz., that, as far back as the year 1785, Dr. van Marum, at Haarlem, noticed that oxygen was curiously modified after it had been submitted for some time to the passage of electric sparks. He proved that the gas thus acted upon oxidised mercury very rapidly at the ordinary temperature of the air; and he also particularly noticed the peculiar odour the gas had acquired. The author quotes the following new method for the preparation of ozone:—Binoxide of barium is treated for this purpose with sulphuric acid; the oxygen given off is strongly ozonised. It is also observed that the presence of ozone in air, although very probable, has not been hitherto undeniably proved, while the presence in air of various other substances, among these, hyponitric acid, cannot be denied; and a great difficulty arises from the similarity of the reactions with the same reagents exhibited by these bodies. This paper is a complete monograph on ozone.

Researches on the Artificial Digestion of Amylaceous Matter by the Aid of Maltine.—L. Contaret.—Maltine is obtained from barley-malt by steeping that substance in tepid water. The substances thus extracted from malt, and collectively called maltine, or vegetable diastase, has been applied by the author for experimenting upon starchy substances, and converting these, at about 38°, and under the influence of water, into dextrine and sugar (glucose). The author's maltine is very similar to, if nor identical with, the much-vaunted malt extract.

Method Adopted by the late L. Foucault to Recognise whether the surface of a Mirror is Rigorously Parabolic.—A. Martin.

A New Kind of Thermometer.—A. Lamy.—Some time ago, this author proposed a pyrometer based upon the dissociation of carbonate of lime; he now proposes to apply ammoniacal chloride of calcium, which gives off ammonia at low temperatures. The instrument is to be connected with a manometer, which will record the temperature. The contrivance is to be especially adapted to record the temperature at different depths under the surface of the soil. M. E. Becquerel and others very properly observe that better and far more accurate means for accomplishing this purpose exist already, and are daily successfully employed.

Some Observations on the Diamond Found at Blaschkowitz (Bohemia).—A. Schafaritz.—In order to settle all doubt about the true nature of this diamond, the author has burned, in a current of oxygen, and with suitably-arranged apparatus, a sufficient quantity of this stone to prove that it is completely consumed, yielding only carbonic acid. We, moreover, learn from this paper that the geological conditions of the locality where this stone has been found bears a great resemblance to the geological conditions of that portion of the Brazil where diamonds are constantly sought for.

Combination of the Hydracids with Bromated Ethylen and Propylen.—M. Reboul.

Action of the Haloids in Free State, and of some Chlorides, upon Glucose.—A. Colley.—After referring to the action of the haloids upon anhydrous glucose at a high temperature (80° to 112°), and, also, after having mentioned the influence of water and the action of hydrochloric acid upon glucose, the author describes, at great length, the action of chloride of acetyl upon this substance when placed in a sealed tube; the result is the formation of acetochlorhydrose, a solid body capable of crystallising, insoluble in water, and soluble in alcohol, ether, and chloroform. On being submitted to elementary organic analysis, results were obtained leading to the formula $C_6H_7(C_2H_3O)_4O_5Cl$. Its mode of derivation from glucose is represented by—

$$C_6H_{12}O_6+5C_2H_3OCl=C_6H_7(C_2H_3O)_4Cl+C_2H_4O_2+4HCl.$$

This formula is exactly reproduced from the original.

A New Phosphated Compound.—L. Darmstädter and A. Henninger.—While causing an ethereal solution of phosphuretted hydrogen to act upon chloride of cyanogen, the authors have obtained—

$$P\left\{\begin{matrix}CN\\C_2H_5\\H\end{matrix}\right.$$

a solid substance, crystallising in rhombic-shaped crystals, fusing at about 50°, and volatilised without decomposition. This cyanethylphosphide is readily soluble in water, alcohol, and ether, and its formation is elucidated by—

$$CNCl+PH_3+(C_2H_5)_2O=CNPH(C_2H_5)+HCl+C_2H_5.OH.$$

Chemical and Therapeutical Researches of the Thermo-Mineral Water of the Solfatara of Ponzzoles (Italy).—S. De Luca.—This mineral spring, met with near Naples, is remarkable for containing arsenic, free sulphuric acid, and a number of other substances, amounting per litre, to—Sulphuric acid (calculated in anhydrous state), 1·473 grms.; chlorine, 0·0085; protoxide of iron, 0·1105; lime, 0·101; magnesia, 0·0225; potassa, 0·017; ammonia, 0.0135; alumina, 0·335; silica, 0·315; soda, manganese, arsenic, and nitrogenised organic matter, traces. As regards the presence of arsenic, the author states that the volcanic fumarola, close to the spring, yields vapours among which the presence of sulphide of arsenic is readily made visible, by holding, for a moment, any cool substance, even paper, at the place whence they exude to obtain crystals of sulphide of arsenic. This water yields, on evaporation, excellent alum, and is therapeutically applied, internally as well as externally. The temperature is not mentioned.

February 28, 1870.

This number contains the following original papers and memoirs relating to chemistry and allied sciences:—

Modifications Produced by Magnetism in the Light Emitted by Rarefied Gases Enclosed in so-called Geissler Tubes.—Rev. A. Secchi, S.J.

New Studies on Propylic, Butylic, and Amylic Aldehydes.—I. Pierre and E. Puchot.—Pure propylic aldehyde is a limpid, colourless liquid, boiling at 46°; it emits a suffocating odour; is so prone to oxidation, that it is difficult to obtain it free from propionic acid; reduces nitrate of silver readily; sp. gr. at 0°, 0·8327, at 32°, 0·7966. Butylic aldehyde is also a limpid, colourless liquid, which readily reduces salts of silver, and boils at 62°; sp. gr. at 0°, 0·8226, at 27·75°, 0·7919. Amylic aldehyde, also a li-

quid, boils at 92·5°, and is very readily converted, by oxidation, into valerianic acid; sp. gr., at 0°, 0·822, at 4·34°, 0·779.

Determination of the Form of our Globe by Experimental Means.—G. Lambert.

Note on the Physical Condition of Bodies.—F. Lucas.—Both these papers are physico-mathematical essays.

Observations made of a Meteorite at the Observatory at Paris.—MM. Wolff, Adré, and Capitanes.—A concise account of a meteorite seen on the 26th of February last, at 9·35 p.m.

Foucault's Method of Autocollimation, and its Application to the Study of Parabolic Mirrors.—A. Martin.

Divers Orders of Spectra of the Simple Bodies.—Dr. Dubrunfaut.

Solution of Reducing Gases by Molten Iron and Carbureis of Iron when in Liquid State by Fusion.—H. Carom.—The author of this paper states that the spirting of fused cast-iron is not due, as has been stated by M. H. St. Claire-Deville, to the solution (or absorption) of certain gases in these metals while at a high temperature, but is the result of a peculiar reaction which continues until the metal is completely solidified. M. H. St. Claire-Deville replies that, whether the gas be oxide of carbon or hydrogen mixed, or whether it be oxide of carbon only, it is the gas which causes the spirting, and often even the projection, of large quantities of molten metal to great distances.

Oxidation of Iron.—F. C. Calvert.—This paper contains a full description of a series of experiments made with the view to establish precisely the causes of and conditions under which iron rusts. The author comes to the conclusion that the carbonic acid, as well as the watery vapour, contained in the atmosphere concur jointly in causing iron to rust. Prof. Chevreul makes the following observations on this subject:—Claude Bourdelin was the first who observed (in 1683) that ammonia is formed when aërated water acts upon steel. In 1720, E. F. Geoffroy found that iron rust formed in the air contains moisture and ammonia. Vauquelin found ammonia in the specks of rust formed upon a chopper, of which it was suspected that it had been used for murdering somebody; the presence of ammonia in iron rust should, therefore, be cautiously dealt with in medico-legal questions. According to Dr. Calvert, pure iron does not decompose pure water at the ordinary temperature; and if this is correct, the fact observed by Prof. Chevreul, that the white hydrated protoxide of iron decomposes water, becomes more interesting.

Dissociation of Ammoniacal Compounds.—F. Isambert.—The author describes a series of experiments made with anhydrous double salts of ammonia, zinc, and cadmium sulphates, and the dissociation of these by heat (100°), aided by vacuum. The general conclusion arrived at by the author is that, by the action of ammonia gas upon the chlorides or sulphates of the metals alluded to, there is, independently of the chemically-combined ammonia, some of that gas absorbed in the same manner as charcoal is capable of doing. The compound $CdOSO_3,3NH_3$ is to be considered as made up of $(CdOSO_3,NH_3)2NH_3$.

Aurora Borealis and other Meteorological Phenomena Seen and Observed in Piedmont on January 3rd, 1870.—Rev. P. Denza, S. J.

Cosmos, February 26, 1870.

The Newton-Pascal Forgeries.—The forger of these and other documents (a number of 27,000, only taking into account those purchased by M. Chasles, who paid £5,600 for the same) is now on his trial before one of the tribunals of Paris.

Discovery of Coal in the Brazil.—R. von Brause states that he has discovered coal of very good quality in the Province of Santa Catharina, near Ararangua. The seam which crops out has been explored for a distance of some 30 miles, and found to be of an average thickness of 1 metre. This coal has been thoroughly tested and analysed by Dr. Netto, of Rio de Janeiro, and is interesting as one of the very few instances of a true coal occurring in a recent geological formation, although in the United States and in Hanover (on the very borders of the Netherlands), two or three such occurrences are on record. The coal here alluded to is an excellent quality of gas coal.

Curious Instance of Spontaneous Combustion of the Human Body.—Dr. Bertholle.—This paper relates a duly authenticated case of this rare phenomenon. The victim, a woman aged 37 years, was a confirmed drunkard. Many of our readers will recollect, perhaps, that Prof. Liebig wrote a paper on this subject some years ago, when the medico-legal question arose concerning the death of a noble lady in Germany.

Phosphide of Calcium Applied to Life-Buoys.—F. Silvas.—Experiments have been made at Toulon to try to attach to life-buoys another floating body provided with phosphide of calcium, which, on becoming wet, gives off spontaneously combustible phosphuretted hydrogen, thus emitting light to guide the man who might have fallen overboard and be in search of the life-buoy.

Revue Hebdomadaire de Chimie, February 17, 1870.

Modifications in the Mercurial Air-Pump.—Messrs. Alvergniat Frères.—The improvement here alluded to cannot be well understood without reproduction of the cut; but there is no doubt that this modification will soon be generally adopted, since it greatly aids the efficiency of this apparatus.

Quality of the Kerosene Oil as Met with and Sold at New York.—C. F. Chandler.—The first portion of a report to the Imperial City's Board of Health on this subject.

Carbonisation of Dry (Non-Caking) Coal.—E. Péricot and T. Appolt.—This paper is a first instalment on the means by which coke of good quality may be made from *houille maigre*—that is to say non-caking coal. This property may be due to either excess of carbon (as in anthracite), excess of oxygen (as, for instance, in the coal from Saarbrück, which contains 17 per cent of that element), or to excess of ash (as, for instance, the Boghead and some other Cannel coals); but, as regards the latter, there are other causes in play for preventing them from caking, and, among these, the water they contain in a peculiar manner.

February 24, 1870.

This number contains the continuation of the following original papers:—

Quality of the Kerosene Oil as Sold at New York.—Prof. C. F. Chandler.—The specific gravity of the native petroleums varies from 0·773 to 0·910; and the average composition of crude Pennsylvania petroleum is, in 100 parts—Gazoline (sp. gr., 0·744), 10 parts; naphtha (sp. gr., 0·752), 10 parts; oils fit for burning and lubrication, 76 parts, varying in sp. gr. from 0·844 to 0·760. The paper further contains a large amount of information concerning the American regulations for the sale and testing of petroleum, and gives a tabulated review of the composition of some specimens of kerosene sold at New York, from which it appears that some kinds contain no less than 90 per cent of the very volatile oils, while in other instances, again, the quantity of the latter is *nil*.

Carbonisation (Coke Manufacture) of Non-Caking Coal.—The main point here brought forward is the well-known washing process, whereby the earthy constituents of the coal are removed, and, having become decreased in quantity, admit of the agglomeration of the organic matter when heat is applied. The admixture of a

good quality of caking coal is advocated for obtaining coke from anthracite.

Holtz's Electrical Machine.—M. L. Mène.—This complete description of this machine, as improved by M. Bouchotte, is accompanied by a couple of woodcuts.

Annales de Chimie et de Physique, January, 1870.

This number contains only two original memoirs:—

Estimation of Carbon in Cast-Iron, Wrought-Iron, and Steel.—M. Boussingault.—The paper, a lengthy essay on this subject, opens with the quotation of the results of an analysis of white cast-iron smelted with charcoal at Medellin, in New Grenada. In 100 parts, this substance contained:—Combined graphite, 4·40; silicium, 0·75; phosphorus, 0·07; sulphur, traces; nitrogen, 0·0118; manganese, 0·84; chromium, 1·95; vanadium, traces; iron, 92·50. The paper contains the following sections, headed—Attacking iron by the dry process—*i.e.*, with bichloride of mercury; attacking iron by the wet process; estimation of carbon in cast iron, wrought iron, and steel.

Temperature of Flames, and on Dissociation.—E. Vicaire.—This is the first instalment of a lengthy memoir on this subject, accompanied by several engravings.

February, 1870.

This number contains continuation and end of last-named memoir, and—

Migration of Nitrogen during the Process of Beet-Root Sugar Manufacture.—A. Renard.

Optical and Crystallographical Researches on the Clino-Rhombic Form of Tungsten.—M. des Cloizeaux.

Simultaneous Estimation of Carbon, Hydrogen, and Nitrogen in the Elementary Analysis of Organic Substances.—Th. Schlœsing.—This excellent memoir cannot be well understood without the reproduction of the several woodcuts annexed to it.

On the Effect Motion has upon the Vibrations of Sound, and on the Length of the Wave of the Rays of Light.—H. Fizeau.

Regulator for the Use of Gas in Chemical Laboratories.—Th. Schlœsing.—Cannot be usefully abstracted without the reproduction of the woodcuts.

Researches on Camphor and some of its Derivatives.—H. Baubigny.—This is the first portion of a lengthy monograph on this subject, divided into the following sections:—Introduction, treating briefly on the researches made on camphor by various authors; action of sodium upon camphor; action of water upon sodium products, and formation of borneol; action of the bromides and iodides of the radicals of the diatomic alcohols upon the sodium derivatives from camphor.

Moniteur Scientifique, No. 317, March 1, 1870.

Contains the following original papers:—

Oil Refining.—M. de Keyer.—This process is equally applicable to all fat. or fixed oils. Take, for 100 kilos. of oil 600 grms. of liquid ammonia, diluted with the same quantity of water; the mixture is vigorously stirred for about half-an-hour, and next left quietly standing for three days, care being taken to keep the vessel containing the mixture well closed. The oil having been decanted from the sediment (which is applied for soap-making), is ready for use after washing with water and filtration.

Researches on Molasses, and on the Divers Processes of Sugar Refining as Applied in Paris.—Dr. Dubrunfaut.—A lengthy monograph, of interest chiefly to sugar refiners.

Direct Application of Suint to the Manufacture of Cyanides.—Leon Sauvage.—In reference to what was stated in this periodical (see abstract, vol. xxi., p. 71), this author writes to say that he obtained, on the 30th of December, 1864, a *brevet d'invention* for this invention, and that this *brevet* is now public property. The author's object is to state that his is the right of priority.

Journal für Praktische Chemie, No. 18, 1869.

This number contains the following original papers and memoirs:—

Preparation of Pure Titanic Acid and its Separation from Zirconium and Iron.—G. Streit and B. Franz.—The first section of this paper is devoted to a comparative review of the methods hitherto in use for the disintegration and solution of minerals containing the substances named above. The preparation of titanic acid by the method suggested by the authors, consists in fusing rutile, first, with three times its weight of carbonate of potassa at a high temperature in fire-clay crucibles. The fused mass is poured out on a piece of sheet-iron, so as to form, on cooling, a thin cake: this is next ground to powder, and exhausted with water, and, after removal of the silica, treated with crude hydrochloric acid, no heat being at first applied. The several operations of filtration and washing by decantation having been got through, the titanic acid is precipitated by means of a mixture of acetic acid and dilute sulphuric acid, and boiling, by the aid of steam, for some ten hours. The separation of zirconia from titanic acid is discussed at great length; the authors experimented with a solution containing 4·23 grms. of TiO_2, 0·188 of FeO, and 0·062 of Fe_2O_3, and added thereto the sulphuric acid solution of 0·613 grm. of zirconia. To the solution was then added its own bulk of acetic acid, and the liquid boiled; all the titanic acid was hereby precipitated, while iron and zirconia remained in solution. From the filtrate the two latter substances were precipitated by ammonia, and, after having been collected upon a filter, washed, dried, ignited, and weighed, the iron was estimated in the re-dissolved substance volumetrically.

Formation of Sulphuretted Hydrogen from Water and Sulphur.—J. Meyers.—While experimenting on the boiling-point of sulphur, the author detected the presence of sulphuretted hydrogen; and this induced him to make, purposely, an experiment whereby steam was made to pass over sulphur kept boiling in a tube. A large quantity of sulphuretted hydrogen was formed, and, simultaneously, pentathionic acid. The following formula explains the process:—

$$15S+10H_2O=10H_2S+5SO_2=H_2S_5O_6+5H_2S+5S+4H_2O.$$

This number contains the notice that Dr. H. Kolbe has been appointed chief editor of this journal, which will in future appear in fortnightly numbers, excepting that during the months of August and September no issue takes place; but, exceptionally, the journal will be published during these months in the current year, to make up for backward appearance during the first two months of 1870.

Revue des Cours Scientifiques de la France et de l'Etranger, February 26, 1870.

This number does not contain any papers relating to chemistry or sciences allied therewith.

Comptes Rendus des Séances de l'Académie des Sciences, March 7, 1870.

This number contains the following papers and memoirs relating to chemistry and physical sciences:—

Electromotive Force of Divers Substances, as, for instance, Pure Carbon, Gold, Platinum, &c., in the Presence of Water and other Fluids.—E. Becquerel.—This paper contains the description of a series of

very accurate experiments made with chemically pure substances. Among the curious facts elicited is this, that pure gold, obtained from the French Mint, is acted upon by pure water in a manner not hitherto explained, but which gives the author occasion to ask whether, possibly, gold does not contain another substance, which has not been discovered, or whether, perhaps, the slow action of the water is not the cause of the disaggregation of the gold, and thus explains the fact of its being found in rivers in the state of dust.

Elucidating Remarks on M. Charles.—J. Dupuis.—In the meeting of the 7th of February last, mention was made of some papers, manuscripts, and books presented to the Academy, formerly the property of the celebrated physicist, Charles. It appears that some confusion has arisen, since there have been two scientific men bearing this surname—viz., Jacques, born at Cluny, a celebrated mathematician, who died on the 22nd of August, 1791; and Jacques Alexandre César, born at Baugency, on the 12th of November, 1746, who died in 1823, and it is this latter celebrated physicist whose papers, memoirs, &c., have been accepted by the Academy for its library.

Observations of the Colours Exhibited by Rarefied Gases when Submitted to Spectrum Analysis.—J. Dubrunfaut.

Electromotive Force which Platinum Evolves when brought into Contact with Divers Liquids.—J. M. Gaugain.

Formation of Icicles.—Lecoq de Boisbaudran.—A paper illustrated with several woodcuts, absolutely necessary for it to be properly understood.

Illumination of Transparent Bodies.—M. Soret.

Absence of Oxygenated Water in the Snow Fallen at Rouen.—A. Houzeau.—This paper contains an account of very carefully executed experiments to detect the presence of peroxide of hydrogen (*eau oxygénée*) in water obtained from snow, care being taken to prevent the loss or decomposition of the peroxide alluded to. The author's opinion is that, since the experiments made at Kasan undoubtedly proved the presence of the peroxide of hydrogen in snow water, there may exist an essential difference, caused by the locality where it falls. Kasan is situated almost in the centre of the Russian empire, far away from any seas or oceans.

Poisoning with Hydrocyanic Acid and Cyanides.—M. Boujean.—This paper contains a very interesting account of a series of experiments made with living animals, in order to establish positively whether, after their death, such substances as hydrocyanic acid and cyanides can be detected with perfect certainty by chemical analysis. The contents of the paper are too lengthy for full and useful abstraction, but deserve attention, especially for medico-legal questions.

Rain of Sand which occurred in Italy on the 13th and 14th of February last.—Rev. P. Denza, S.J.—This lengthy memoir contains the account of a very curious phenomenon—viz., rain, in the southern parts of Italy, accompanied by a fall of a fine reddish sand, while, in the northern parts of that kingdom, snow fell accompanied by the same substance. The sand has been tested, and found identical with that which is now and then carried by gales of wind from the African desert, not simply into Italy, but even sometimes into Switzerland, where some of it fell, along with snow, at Tseappina (Canton des Grisons). This paper contains many curious facts relating to a phenomenon which is sometimes observed also on the Canary Islands.

Action of Ozone upon Nitroglycerine, Dynamite, and other Explosive Substances.—J. Jouglet.—According to the author's experiments, nitroglycerine, dynamite, iodide of nitrogen, chloride of nitrogen, and some other similar compounds explode the very moment they are brought into contact with ozone; so that, for instance, a drop of nitroglycerine, introduced into a vessel containing ozone, causes an instantaneous explosion. Picrate of potassa gunpowder and ordinary gunpowder are slowly decomposed by ozone, a decomposition which, as regards the last-named substance, takes several weeks before it is perceptible.

Les Mondes, February 24, 1870.

Solar Temperature, and the Means by which it is Kept up.—Rev. A. Secchi, S.J.—The *résumé* of this memoir, originally published in the Italian language, is given in the following few lines:—The sun is a globe possessed of an enormously-high temperature, undoubtedly reaching many millions of degrees; but our means of estimating that temperature are very imperfect. As to the origin of this high degree of heat, it may have been the result of the force of gravitation which has united the elements of which the central point of the system (viz., of our solar) has been made up; the initial temperature, therefore, the result of mechanical action, will, of necessity, have been far greater than the present temperature of the sun is, which is certainly cooling down. However great this loss of heat may be, it is imperceptible to us, since it is slowly taking place, and partly compensated by chemical actions which take place in the sun, which is, in all probability, in its interior, a mass of strongly-compressed and condensed nebulous matter.

Handbook of General Cosmography.—H. J. Klein.—This is highly eulogised as a compendium explaining, in a clear and precise style, everything at present known of our solar system and its constitution. The author has followed, as pattern, the celebrated von Humboldt's *Cosmos*.

Cleansing of Raw Sugars, and Extraction of Sugar from Molasses, by means of the Saccharate of Hydrocarbonate of Lime.—J. Boivin and T. Loiseau.—Under the name of *sucrate d'hydrocarbonate de chaux* (saccharate of hydrocarbonate of lime), the authors describe, but do not exactly define, a peculiar compound of lime-water and sugar, to which some peculiar properties are ascribed. The main gist of the paper is a lengthy account of an enumeration of the processes in use for refining sugar at the refinery of MM. Sommier and Co., La Villette, Paris, according to the system of the authors, but any one acquainted with sugar refining will at once perceive that the paper is vaguely worded, and that there is a want of precision in it.

Apparatus for Heating the Feed-Water for Steam Boilers.—H. N. Watson.—This contrivance, which could not be well understood without the reproduction of the cut, is an ingenious arrangement, well deserving the attention of those who wish to save fuel. Emile Leroux, C. E., 43, Rue de Verneuil, Paris, gives full particulars on this subject.

Tungsten Blue.—Tessié du Motay.—Dissolve in a sufficient quantity of water, and successively, 10 parts of tungstate of soda, 8 of tin-salt (protochloride of tin), 5 of ferrocyanide of potassium, and 1 of perchloride of iron. When all these substances are dissolved, the mixture is thoroughly stirred up, and the sediment which is formed is separated by filtration. As soon as the liquid has run off, the moist pasty matter is spread out in thin layers upon suitable glass plates, or shallow dishes, and for several days exposed to the action of strong daylight and sunshine. This slowly causes the formation of a beautifully-blue pigment; and this action may be accelerated by washing the material, so as to remove the matters soluble in water which it yet contains. The blue material has a great similarity with Prussian blue, but differs from it by not being bleached by sunlight; akin to Prussian blue, it resists the action of acids, but not of alkalies. The tungsten blue can be heated to about 180° without decomposition. Its per centage composition, in 100 parts, is—Water, 7·85; tin, 31·69; iron, 5·13; cyanogen, 19·41; blue oxide of tungsten, 35·60; total, 99·68. This blue is not affected by artificial light at all, and is sold at the same price as the very best quality of Prussian blue.

Oxyhydrogen Light.—Tessié du Motay.—A lengthy paper, setting forth chiefly matters of domestic economy, as regards the cost of this mode of illumination, and also detailing improvements made whereby the use of lime or zirconia cylinders is replaced by a suitable system of carburation of the hydrogen gas.

March 3, 1870.

Prize Questions Proposed by the Royal Belgian Academy of Sciences, at Brussels.—(We do not quote those belonging either to pure mathematics or natural history. The study of electrical induction currents, based, as much as possible, upon a new series of experiments to be made. A new series of researches to be made, with the view of establishing the chemical composition and the mutual relation existing between the albuminoid substances. A gold medal (value £40) will be given for a successful answer to the last-mentioned question, while the value of the gold medal to be given for the reply to the other question will be £24. Answers, written in Latin, French, or Flemish languages, to be sent, post-paid, to M. Quetelet, the perpetual secretary, on or before June 1, 1871.

Prize Questions Proposed by the Bataafsch Genootschap (Batavian Philosophical Society) at Rotterdam.—We only quote such as belong to chemistry or allied sciences. Determination of the temperature of the water of the oceans at great depth, and in such localities (latitude and longitude) where these determinations have not yet been made; crystallographical examination of such organic compounds as are sufficiently developed to recognise the cleavage of the crystals; determine whether any parts of the sun's surface are possessed of a higher temperature than other portions thereof, and also whether the hotter portions are always the same; the experimental determination of the temperature of decomposition of several chemical compounds, and the estimation of the influence exercised thereupon by the presence of different other substances, and other conditions which may modify that temperature; with at least three liquids, the influence has to be determined which is exercised upon electrolysis when the electrolyte is submitted to pressure: verify, at the same time, whether the facts observed confirm the principle of the conservation of force. By a sufficient number of well-authenticated facts, the question should be settled whether steam boiler explosions are due to a formation of hydrogen gas (decomposition of water), or to the sudden conversion into steam of water previously converted into the spheroidal state; the estimation of the resistance to a galvanic current by liquid mixtures (amalgams in liquid state) of mercury and zinc, and mercury and gold, care being taken that the precise proportions of the metals mixed together, the sp. gr. of each mixture, and the thermo-electric properties such amalgams might possess, be simultaneously indicated; historico-critical account of the observations hitherto made of the electric currents produced in telegraphic wires by thunderstorms and Aurora Borealis. Answer to the question whether any other molecular variations than those produced by the increase of the temperature of bodies affect the rays of the spectrum peculiar to such bodies. Decisive experiments to be taken in order to settle the question between Dr. Tyndall and Prof. Magnus, concerning the greatest absorption of heat by air charged with aqueous vapours. Test, by a series of entirely new experiments, the truth of Dr. Gaugain's statement that conducted electricity is propagated through matter, while free electricity is propagated through the ether. What is the cause of the volcanoes of the Indian Archipelago? The precise estimation of the degree of solubility of gases in liquids, to be determined for at least four gases and eight fluids; the rules generally given for the placing of lightning conductors on buildings should be tested, if possible, by experiments and observations, and therefrom fixed rules established; the more extended study should be made of the conductibility of those electrical conductors termed, by Dr. Gaugain, imperfect conductors; theory, by confirmation, of Holtz's electrical machine; explanation of the phenomena of the spontaneously-becoming charged with electricity of electric conductors placed underground, or underwater, and the means to prevent, or, at least, to neutralize, the effects thereof. For the best answers, a gold medal, value £15, or the money-value, with an additional premium of from £5 to £12; a silver medal for the next best answer. Answers written in Dutch, French, English, German, or Latin languages, accompanied by a sealed billet, bearing outside a motto, and inside the author's name, to be sent, post-paid, to Dr. F. van der Paut, at Rotterdam, on or before the 1st of February, 1870.

Measurement of Forces.—M. Coste.

Movement of the Sea.—J. Quenaut.—This author writes from Montmartin-sur-Mer, and, among other things, states that, according to authentic documents, the islands of Jersey and Guernsey have sunk down, during the lapse of the last 500 years, at least 13 metres.

Capital Punishment by means of the Guillotine.—Dr. E. Decaisne.—We simply quote the title of this paper, very opportunely published, since it contains full explanation and sound refutation of the nonsense which has appeared in print of late concerning the retention of vitality, and even consciousness, after decapitation by this machine, introduced in France in 1791.

March 10, 1870.

Candle-Bearing Tree.—This curious tree is only met with near the river Chagres, in the Isthmus of Panama, and was discovered there by Dr. Siemann. It is the fruit of this tree which so perfectly resembles, in shape and colour, that of unbleached wax candles, which has given rise to its popular name, *palo de velas* (candle tree); the botanical name is *Parmentiera cerifera*, and its fruit is eaten by sheep. The fruit known as quamxilotte, and eaten by the Mexicans as a delicacy, is produced by the *Parmentiera pendulus*.

Secreting Organ of, and the Secretion of Sulphuric Acid by, Gasteropode Molluscs.—Paolo Panceri—Very little is as yet known about the chemical nature of the various fluids produced in and secreted by the non-vertebrated animals. The lengthy paper here quoted describes a very curious phenomenon of the mollusc known as *Dolium galea*, which sometimes grows to a very large size. The saliva of this animal is a colourless, somewhat opalescent liquid, of from 1·025 to 1·030 sp. gr., containing, in 100 parts—Free sulphuric acid, 3·42; combined sulphuric acid, 0·2; combined hydrochloric acid, 0·58; potassa, soda, magnesia, oxide of iron, phosphates, and organic matter, 1·8; water, 94·0. This paper contains, moreover, an anatomical and physiological account of the secretory organs of this animal.

Improved Coffee-Roasting Machine.—M. Marchand.—There is a woodcut annexed to the description of this contrivance, which has been very favourably reported upon by a committee of the chemical Department of the Société d'Encouragement de l'Industrie Nationale.

Revue des Cours Scientifiques de la France et de l'Etranger, March 5, 1870.

From this number, which does not contain any papers relating to chemistry or allied sciences, we learn that M. Delaunay has been appointed Director of the Imperial Observatory at Paris, in lieu of M. Le Verrier.

The Elsasz during the Tertiary Period.—J. Delbos.—An interesting geological paper.

Cosmos, March 5, 1870.

Heating of Steam Boilers.—A. Scheurer-Kestner and E. Meunier.—The authors have made, on the large scale, a series of experiments which prove that only about 60 per

cent of the heat given off by the combustion of coals is really utilised, and the loss is due to the radiation of the exterior surfaces of the boilers. The authors are of opinion that improvements should be directed towards the prevention of this loss of heat; they, moreover, find that the cleaning of the inside of the boilers has great influence, and suggest that this operation of cleaning should be done at short intervals of time.

Preservation of Milk.—Add to every litre (1¼ pints, and 5 oz) of unskimmed milk, previously poured in a well-annealed glass bottle, 40 centigrs. (about 6 grs) of bicarbonate of soda. Place the bottle containing the milk, and well corked, for about four hours in a water-bath heated up to 90° (194° F.). On being taken out, the bottle is varnished over with tar: and in that state the milk it contains will keep sound and sweet for several weeks.

Large Fir Tree.—There has been just cut down, at Arwa, in Hungary, a fir tree, 139 ft. high, and 71 inches in diameter at 2 ft. from the soil. This tree, as regards size, is a specimen now very rarely met with in Europe, though more common to America.

Solid Bisulphide of Carbon.—Dr. Von Wartha.—This has been obtained by the rapid evaporation of this liquid itself in the same way as solid carbonic acid is formed. The solid sulphide melts at 9° F. and has the appearance of small cauliflowers.

Bibliothèque Universelle et Revue Suisse.—Archives des Sciences Physiques et Naturelles, No. 145.

This number, and the following (No. 146), do not contain any original papers relating to chemistry or allied sciences.

Monatsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin, November, 1869.

The only paper relating to chemistry in this number is a lengthy memoir:—

Contribution to the History of the Sulphuretted Urea.—Prof. A. W. Hofmann.—This memoir contains the following subsections:—Desulphuration of the ethyl-sulpho ureas; desulphuration of the diethyl-sulpho ureas; desulphuration of diethyl urea in the presence of ethylamine; desulphuration of diethyl-sulpho urea in the presence of ammonia; desulphuration of monoethyl-sulpho urea; desulphuration of normal sulpho urea.

Annales du Génie Civil, February, 1870.

This number contains a paper on the—

Utilisation of the Heather.—E. Dromard.—In France, and in a great many other European countries, very large tracts of land are uncultivated and left waste, producing nothing but heather and similar plants. The author's lengthy memoir describes practical methods whereby these plants are employed for the production of charcoal, acetic acid, tar, and other useful products, and the soil so cleared as to become fit for the cultivation of various kinds of fir trees. The contents of this paper are of great interest to agriculturists and landowners.

Pharmaceutische Zeitschrift für Russland, December, 1869.

The only original paper contained in this number is the end of the extremely lengthy memoir—

Monograph on Inuline.—Dr. Dragendorff.

Journal fur Gasbeleuchtung, January, 1870.

Although not directly bearing upon the matters generally treated in our journal, we call attention to an excellent paper, illustrated with a series of beautifully-executed engravings, on the—

Application of Gas Illumination to Theatres.—L. Diehl.—Considering that these buildings so frequently become the prey of flames, occasioning serious loss of life by their conflagrations, this paper is of great interest to all concerned in such matters.

Jahrbuch der Kaiserlich-Königlichen Geologischen Reichsanstalt, No. 4, 1869.

This number contains—

Contribution to the Mineralogical Topography of Austria and Hungary.—F. von Vivenot.—This useful and concise catalogue is alphabetically arranged, as far as the minerals are concerned, while the names of the localities are printed in italics.

Polytechnisches Journal von Dingler, second number for January, 1870.

This number contains the following original papers relating to chemistry and allied sciences:—

Possible Causes of Steam-Boiler Explosions.—Dr. H. Schröder.

Bessemer Steel and Heaton Steel Processes.—T. Schinz.

Colorimetric Carbon-Test of Eggertz.—Dr. Dingler.—The result of the author's researches on this subject is, that Eggertz's process is only applicable when the same quantities and qualities of raw materials are continuously applied for the production of cast-iron; but the test fails to give good results with iron and steel of different origin, since it has been found that the presence of other substances—viz., sulphur, copper, phosphorus, and silicium—affect the accuracy of the test.

Chemical Constitution of the Colouring Matter of the Alder Tree.—F. Dreykorn and E. Reichardt.—It is a well-known fact that the wood of the *Alnus glutinosa, L.*, when recently cut, exhibits a series of colourations, rapidly changing from yellow to reddish brown. The authors isolated this colouring matter, which is perfectly insoluble in ether, benzol, and sulphide of carbon, difficultly soluble in absolute alcohol and boiling water, but readily soluble in dilute alcohol in every proportion. The different tests applied to this substance resulted in defining it as a peculiar tannin material; with gelatine solution, it is precipitated, with chloride of iron it yields a green precipitate, and its combinations with the heavy metals are insoluble in water; its formula is $C_{54}H_{28}O_{22}$. This material yields, when split up by the action of sulphuric acid, sugar, and a peculiar reddish brown-coloured resinous substance, insoluble in water and ether, difficultly soluble in alcohol, readily soluble in caustic soda solution and in ammonia, from which solutions it is precipitated again by acids. The splitting-up of the substances is represented by—

$$3(2HO,C_{54}H_{26}O_{20})+HO=3(2HO,C_{46}H_{14}O_{11}(+2(C_{12}H_{14}O_{14}).$$

The memoir describes further, at length, the action of alkalies upon this alder tannin, and the products of the dry, or destructive distillation. The result of these researches is that, by the action of alkalies, there are formed protechuic acid, phloroglucine, and acetic acid. The dry distillation yields pyrocatechine.

Manufacture of Fatty Acids from the Washing of Wool and the Soap-suds Thereof.—Dr. Dingler.—After referring briefly to the researches of Houzeau Muiron on this subject, the author discusses, at great length, this topic; and the chief result is that a material is obtainable, by suitable treatment of the wash-waters of wool, which contains, after the bulk of the water has been removed by

pressure, in 100 parts—Water, 10·66; fatty matters, 34·74; sundry organic matters, 22·37; fine sand, 30·32; soluble silica, 0·08; sulphuric acid, 0·28; phosphoric acid, 0·09: oxide of iron and alumina, 0·99; lime, 0·25; magnesia, 0·10; alkalies, 0·12. This material has been applied for the manufacture of gas, 100 lbs. of it yielding 469 25 cubic feet free from sulphur compounds and of far greater illuminating power than good coal gas. The fatty matters can be extracted, if desired by means of sulphide of carbon.

Journal de Pharmacie et de Chimie, February, 1870.

This number contains the following original papers:—

Sulpho-Carbonic Extracts, and their Application in the Preparation of Medicinal Oils.—J. Lefort.—This is strictly a pharmaco-technical essay, treating, under several separate divisions, on the preparation and properties of extracts (from various medicinal plants) by the employment of sulphide of carbon (refined, of course), and the further application of the extracts thus obtained, to the preparation of medicinal oils.

Adulteration of Cochineal.—E. Baudriment.—The author states that the more common kinds of this dye material are first softened and swollen, by means of steam, and next rolled about in artificial sulphate of baryta, whereby the substance assumes the appearance of a superior article. The fraud can, however, be readily detected, since, in the first place, the genuine article contains only from 4 to 6 per cent. of water, and this mode of adulteration increases that quantity to 11 per cent.; secondly, the quantity, as well as the quality of the ash, is entirely changed. The author found from 19·5 to 20 per cent of sulphate of baryta in the ash, which, when no adulteration has been attempted, contains no trace of this salt.

Poisoning with the Berries of the Honeysuckle.—Dr. Duval.—That this plant is rather dangerous, on account of its poisonous properties, is well known, but the climate it is cultivated in has some modifying influence. The case here related did not end fatally.

Indian and China Isinglass.—J. L. Soubeiran.—The author states that the different varieties of this article, as met with in the trade, may be recognised as follows:—Russian isinglass dissolves rapidly and instantaneously in hot water, leaving hardly ever more than at most 2 per cent insoluble residue; Bengal isinglass dissolves readily, but leaves from 7 to 13 per cent of residue. The taste of Russian isinglass is pleasant and sweet; it yields a very firm gelatine, which is perfectly transparent. The Bengal, or Indian kind, often has a fishy taste, and the gelatine it yields is not clear. The Brazilian isinglass yields an opaque, milky-looking gelatine, and its taste is acrid. China isinglass is a rare article in the European markets.

Journal für Praktische Chemie, No. 19, 1869.

This number, which, it should be observed, was published only by the end of last January, in consequence of an interruption having taken place by the death of the editors, as well as the publisher, of this periodical, contains the following original papers and memoirs:—

On the Iodated Salicylic Acids, Oxysalicylic Acid, and Hypogallic Acid.—Dr. P. Liechti.—In the introduction to this memoir, the author refers to the researches of others on this subject, and states that, as regards the solubility of salicylic acid in water, one part thereof requires, at 10°, 2500, at 18°, 1818, and at boiling temperature, from 15 to 20 parts of that fluid for solution. Monoiodsalicylic acid—

$$C_7H_5IO_3 = C_6H_3I \begin{cases} CO.OH \\ OH \end{cases}$$

a crystalline substance, anhydrous, and fusing at 184°, but when covered with water at 98°. One part of this acid requires, at 20°, 893, and at 100°, 104 parts of water for solution. The solutions of this acid and of its salts yield, with chloride of iron, a brilliant violet colouration. The acid contains 48·2 per cent of iodine. Several of the salts of this acid are described at length. Di-iodsalicylic acid—

$$C_7H_4I_2O_3 = C\ H_2I_2 \begin{cases} CO.OH \\ OH \end{cases}$$

a semi-crystalline mass, anhydrous, soluble in 1428 parts of water at 15°, and 656 parts at 100°; readily soluble in alcohol and ether; and becomes decomposed when heated to about 197°. The reaction with chloride of iron is the same in this instance as just alluded to. It contains 65·2 per cent of iodine. Among the salts of this acid, the baryta salts are the most interesting. Oxysalicylic acid—

$$C_7H_6O_4 = C_6H_3 \begin{cases} CO.OH \\ 2OH \end{cases}$$

The author says that, notwithstanding there exists a great similarity between this acid and hypogallic acid, he does not think that these substances are identical. Oxysalicylic acid requires 587 parts of water at 21° for its solution, but is readily soluble in boiling water; fusion point, 183°. Even in the cold, this acid reduces an ammoniacal silver solution. The preparation of the oxysalicylic ether is described at great length. In pure state, this substance is a solid crystalline material, fusing at 78°, readily soluble in alcohol and ether, and difficultly so in water. This solution reduces neutral nitrate of silver to the metallic state, even in the cold, and yields, with acetate of lead, a precipitate soluble in acetic acid. Bichloride of mercury is not at all affected by contact with this substance, which also yields with chloride of iron a beautifully deep blue-coloured solution. Opinic and isopinic acids are next described, and the author's researches, compared with those of Drs. Matthiessen and Foster on this same subject. According to Dr. Liechti, opinic and isopinic acids are peculiar modifications of hypogallic acid.

Action of Permanganate of Potassa upon Quinine.—Dr. G. Kerner.—One part of pure quinine is dissolved in excess of nitric or hydrochloric acid in such a manner that a bulk of 100 c.c. contains about 1 grm. of the alkaloid; this solution is heated to between 50° and 60°, and there is then added to it a concentrated solution of two parts of crystallised permanganate of potassa in water, care being taken to keep the fluid well stirred. After removal of the peroxide of manganese, the liquid (which should have an alkaline reaction) is evaporated to about one-eighth of its previous bulk, and next acidified, whereby the newly-formed product of oxidation is precipitated. After having been purified, by frequent re-crystallisation from water, aided, for the removal of some colouring matter, by animal charcoal, a hard crystalline substance is obtained, difficultly soluble in cold water and alcohol, but more readily so in these liquids at their boiling temperature. In many respects, excepting taste and alkaline reaction, this substance exhibits properties very similar in character to those of quinine. The formula of this body, which is dihydroxyl-quinine, is $C_{20}H_{26}N_2O_4 + 4H_2O$, and its formation from quinine is represented by $C_{20}H_{24}N_2O_2 + H_2O + O = C_{20}H_{26}N_2O_4$.

Action of Fremy's Osmiamide upon Animal Tissues.—Ph. Owsjannikow.—This paper is devoted to the description of the action of Fremy's osmiamide upon tissues, viz., for microscopico-histological use, and has nothing to do with chemistry. What Fremy's compound is meant is not stated.

Comptes Rendus des Séances de l'Académie des Sciences, March 14, 1870.

The number contains the following original papers relating to chemistry and allied sciences:—

Photographical Observation of the Passage of Venus, and on an Apparatus of M. Laussedat.—M. Faye.—Owing to the general importance of this lengthy memoir, we quote the title here.

On the Nascent State.—H. Sainte-Claire Deville.—Continuation of a former paper on this subject, and, like the first instalment, unsuitable for any useful abstraction. There are added to this paper several tabulated forms containing the results obtained.

General Theory of Chemical Action.—E. J. Maumené.—A memoir on this subject was read at the meeting, but is not published.

Experiments on the Velocity of the Propagation of Sound in Water contained in an Iron Tube of 0·8 Metre (31·496 Inches Diameter.—F. André.—The author describes, minutely, the arrangements made for conducting his experiments, and states that, while the temperature of the water, which entirely filled the tube, was 20° at the top end of the tube and 13° at the lower, the temperature of the air being 18°, he found, as the result of his experiments, that the velocity of the sound per second of time was 897·8 metres. Dr. Wertheim deduced, from his experiments with brass organ-pipes, that the velocity of propagation of sound in water was 1173 metres for the same space of time. MM. Colladon and Sturm, while experimenting on this subject on the Lake of Geneva, found the velocity 1435 metres for a second of time.

Mechanical Properties of Steel Containing Phosphorus.—L. Gruner.—The results arrived at by this author may be summarised as follows:—Phosphorus present in steel in a quantity of from 0·002 to 0·003 causes the metal to be rigid; it tends even to increase the elasticity and the resistance to breaking, but does not modify the hardness. Such steel, however, is wanting in real strength and toughness; it is brittle (*aigre*)—that is to say, does not withstand shocks. The general result is, therefore, that even very small quantities of phosphorus present in steel do not only not improve, but certainly deteriorate, its good qualities. Prof. Boussingault concurs in this view, and stated at the meeting that Dr. Salet, the chief assistant to Prof. Wurtz, has arranged an ingeniously-constructed apparatus to detect the smallest possible quantity of phosphorus in iron and steel, by means of the spectrum produced by the combustion of the hydrogen obtained by the action of chlorhydric acid on the metal.

Revue des Cours Scientifiques de la France et de l'Etranger, No. 15, March 12, 1870.

This number contains an excellent paper—

Lecture on the Shape and Figure of our Globe.—C. Wolf.—The contents of this paper, although not belonging to the sciences usually treated of by us, deserves the attention of all who wish to read a clear and concise account of the highly-refined scientific methods brought to bear upon the determination of the shape of the globe we inhabit. The author forgets to mention that the first measurement of a portion of a meridian arc ever made was executed very early in the seventeenth century by the celebrated mathematician, Simon Stevin, the teacher of Prince Maurice of Orange, and the inventor of carriages moved by the force of the wind, aided by sails. To Dominico Cassini is due the honour of having first suggested triangulations.

We also learn from this paper that the well-known physicist, Dr. Lallemand, has been transferred from the University of Montpellier to that of Poitiers, to fill the chair left vacant by the death of Dr. Tronessard there.

March 19, 1870.

This number does not contain any papers relating to chemistry, but we quote the titles of two excellent lectures published here, viz.:—

On the Evolution of Scientific Medicine and its Present State.—Dr. C. Bernard; and—

Man of the Tertiary Period in America, and the Theory of Multiple-Centres of Creation.—M. Hamy.

Cosmos, March 12, 1870.

Modification of Fortin's Barometer.—A. Amagat.—Instead of the movable bottom to the mercury cup of these barometers, the author displaces the mercury of the reservoir, by means of an iron or glass cylinder, which is forced down into the fluid by the aid of a screw. By this arrangement, the movable bottom (a strong skin) to the mercury cup, or reservoir, is dispensed with.

Fresh Butchers' Meat from America to Europe.—Herrera Yobes—This author proposes to have the hold of vessels lined with metal (what kind of metal is not stated); the bottom of the hold is next covered with either clean straw, saw-dust, or bran, or any other suitable non-conductor of heat. Upon these, the freshly-killed and cut-up meat is placed, and on the top thereof a layer of ice, and on the top of that, again, straw or any of the other substances just named, and next, again, meat and ice, and so on; and after the hold has been thus filled, it is hermetically closed and suitably protected from the effects of hot weather during the journey from Montevideo to Europe.

Consumption of Albumen for Industrial Purposes.—It is a well-known fact that certain industries consume a very large quantity of albumen in some shape or other; sugar refiners, tawers, glove leather makers employ albumen in more or less pure state—in some instances the yolk of eggs only; but the calico-printers are the largest consumers, and this consumption is steadily on the increase. The printing works of the Alsace alone consume annually more than 150,000 kilos. of dried albumen, representing rather more than 37,000,000 of eggs, or the production of 250 000 hens; add to this the consumption of the printing works of other parts of France and of other countries, and there is very little doubt that annually some 150,000,000 eggs are used for that purpose alone.

March 19, 1870.

Amelioration of Wines by Electricity.—Dr. Scoutetten.—As a very tangible proof of the gain obtained by the immediate conversion of young wines into drinking beverages by means of electricity, the author states that, considering that the annual production of wine of France amounts to from 60 to 70 millions of hectolitres (each equal to rather more than 22 gals.) and that at least 10 francs per hectolitre is lost by vapourisation during the time of the maturing of the wine while in casks, this represents a number of from 600 to 700 millions of francs gained by rendering wine fit for immediate consumption by the author's electric process. We may, not inaptly apply here—"Si non e vero e bene trovato."

NOTES AND QUERIES.

Refractive Power of Saline Solutions.—In Chemical News, vol. xiv., p.156 (*Eng. Ed.*), there is a short note, from *Les Mondes*, "On the Refractive Power of Saline Solutions." Can any of your readers refer me to any recent English work or detailed note on the subject?—P.

Bavarian, Vienna, and Belgian Beers.—Messrs. Zacherl and Degelmeyer.—Munich holy father beer—Sp. gr., 103; alcohol, 4·9; extract, 13·0; carbonic acid, 0·08. Bock beer—Sp. gr., 1·02; alcohol, 8·9; extract, 8·5; carbonic acid, 0·08. Salvator beer—Sp. gr., 1·02; alcohol, 4·2; extract, 8·1; carbonic acid, 1·2. Vienna beer (old)—Sp. gr., 1·012; alcohol, 5·2; extract, 5·0; carbonic acid, 1·5. Vienna double beer—Sp. gr., 1·026; alcohol, 5·2; extract, 7·8; carbonic acid, 1·8. Lambick, Bruxelles—Alcohol, 4·7; extract, 3·4. Other variety (same name)—Sp. gr., 1·004; alcohol, 5·5; extract, 3·4; carbonic acid, 2·0. Faro beer, Brussels—Sp. gr., 1·005; alcohol, 4·9; extract, 3·0; carbonic acid, 2·0. Brunswick mommc—Sp. gr., 1·231; alcohol, 3·6; extract, 47·6; carbonic acid, 1·2. Beer brewed at Utrecht—Alcohol, in 100 parts by volume, 5·4; acetic acid, in 100 parts by volume, 0·016; lactic acid, in 100 parts by volume, 0·35; carbonic acid, in 100 parts by volume, 0·159; extract, in 100 parts by weight, 3·49; ash, in 100 parts by weight, 0·36; albumen, in 100 parts by volume (calculated for 15·5 N), 0·46. Beer from Middelburgh—Alcohol (by bulk), 4·95; albuminous compounds, 0·83; sugar, dextrine, and extract, 3·67; ash, 0·42; lactic acid, 0·26; acetic acid, 0·02; carbonic acid, 0·10.

Estimating the Amount of Lamp-Black in Graphite.—Will any of

your readers kindly inform me, if there is any accurate method by which the amount of lamp-black may be estimated in samples of graphite adulterated with it.—J. Rennie.

Coprolite and Bone in Mixed Superphosphates.—Can any one give me a process to quantitatively determine the relative amounts of coprolite and bone in a mixed superphosphate?—W. M. B.

Money-Values of Substances Found in Artificial Manures.—I have occasional applications made to me to add to my certificates of analysis of manurial substances the "value at prices fixed by chemists." I have not done so, for the twofold reason that (1) I do not consider it within the province of the analyst, and (2) that I do not know what the prices are. Can any one, therefore, kindly inform me if this custom obtains amongst respectable analysts? and, if so, what are the various money-values of the substances found in the artificial manures now in use?—W. M. B.

Removing Silica.—Can any of your readers inform me of a practical mode of removing silica from large quantities of carbonate of potassium?—W. H.

Colours and Pigments.—(Reply to "A Reader, Church, near Accrington.")—There are not many works on the subject you refer to. One of the best is "Lehrbuch der Farben Fabrikation, &c., &c.," von T. G. Geuteb (Brunswick: Vieweg and Son, 1860). As to the manufacture of blood and egg albumen, you mean, of course, the preparation of these articles in dry state, fit for preservation; and, for information thereupon, we refer you, among other works, to Schützenberger's "Traite des Couleurs," and to Persoz's "Traité de l'Impression des Tissues."

Distilling Tar.—Consult "Coal, Petroleum, and other Distilled Oils," by Dr. Gesner (New York, London, and Paris: Baillière, 1861; later edition in 1865), and "Industrie der Mineralöle des Petroleums, Paraffins, und der Harze," von H. Peritz (Wien, 1868); also "Chemical Technology, or Chemistry in its Applications to the Arts, &c."

Anthracene.—I should be glad to have a simple test for commercial anthracene, and its price, to see whether it would be worth while to make it where pitch is of little value?—Tar Distiller.

Coprolite and Bone in Mixed Superphosphates.—(Reply to "W. M. B.")—When both the bones and coprolites have been thoroughly dissolved, it will be almost impossible to determine what you desire. If no ammonia salts are present, and the bones applied not too strongly boiled (exhausted by steam), you might (after drying, of course, at 120° C.) get some idea by means of the nitrogen estimation.

Estimating the Amount of Lamp-Black in Graphite.—(Reply to J. Redtropp.)—In the first place, you might make use of the considerable difference of specific gravity of these two substances, and thus separate them from each other by lixivation. Since lamp-black (unless purposely purified or re-calcined) always contains a certain amount of empyreumatic matter, you might extract the graphite you suspect with boiling alcohol (methylated spirit will not do in this case), and come to some idea of the amount of lamp-black added to your graphite by the weight of the empyreumatic matter left after complete exhaustion with alcohol and evaporation of the latter. When completely exhausted, an aqueous solution of boiling caustic soda should not, after the graphite (supposed to be mixed as alluded to) has been quietly settled down, exhibit any sign of brownish or yellowish brown colouration.

Manufacture of Sulphuric Acid.—The following practical objections to Dr. Hofmann's paper, abstracted by you from the *Berichte der Deutschen Chemischen Gesellschaft*, are suggested by my experience, and I should like to elicit the opinions of others who have had experience in that manufacture. If the steam is regulated so as to make the acid of 1·676 to 1·714 sp. gr., as Dr. Hofmann proposes, there is so much nitric oxide dissolved in it as to act very energetically on the lead of the chamber, the liquor in the gauge-drips becoming thick with sulphate of lead, whilst, as a consequence, the chamber wears out very rapidly. At the same time, if the condensed acid in the saucer of the chamber is drawn off at such a high specific gravity, I find that the dissolved nitric oxide is not got rid of by the subsequent boiling, but that the concentrated oil of vitriol gives off abundant red fumes when diluted, causing great inconvenience to those who use it, and, of course, a waste of nitric acid.—H. B. Gibbins.

Analysis of Superphosphates.—Perhaps some of your numerous correspondents would explain to me how it is that, in the analysis of superphosphates and other phosphatic manures, biphosphate of lime is put down as one of the ingredients it contains, and generally underneath it is placed equal to so much phosphate of lime made soluble. Now, I always understood there was no such substance as biphosphate of lime in a superphosphate, but that the phosphates it contained existed as monocalcic phosphate or soluble phosphate, and tricalcic or insoluble phosphate, and not as biphosphate. If such is the case, why not simply put in the analyses the amount of soluble phosphate, or, if I am wrong, the amount of biphosphate, and not put both? This would simplify matters greatly, as, at present, people that have only a limited knowledge of chemistry are very apt to confound the one with the other, not knowing the difference between them.—R. Holmes, Roscommon, Ireland.

Liq. Ammonia.—How and what kind of apparatus is used for making Liq. Ammon. Fort. (880), as I want to use some of that strength daily, to make about 2 cwts. of it at once?—J. Spencer.

Baumé's Hydrometer.—How may I gain a knowledge of the comparison which the common specific gravity glass bears to Baumé's hydrometer and specific gravity glass?—J. T. E.

Alumina.—Can any of your readers tell me whether pure alumina is to be obtained from any source? I have heard that it exists somewhere in Cornwall under the name of "Wavellite," but I can learn no more.—Arthur Warner.

Basic-Salt of Iron.—When a solution of $FeSO_4$ is exposed to the air until no further change occurs, what is the formula of the basic-salt precipitated, and of the acid-salt remaining in solution?—Ferrous Sulphate.

Dr. Schlebler's Apparatus.—I see that mention is made by Mr. Arnot, in his articles on "Sugar Refining," of Dr. Schlebler's apparatus for the amount of carbonates. I cannot find any description of it in the last edition of Fresenius nor in Griffin's "Chemical Handicraft." Can he give me some idea of the instrument, its price, where procurable, and if applicable for the amount of mineral carbonates?—W. E.

Dissolving Cellulose, &c.—(1) Are there any special conditions required, so that cellulose may dissolve in the ammonia solution of copper, or silk in chloride of zinc? (I kept the latter at about 100° F.) (2) Are there any other solvents easily separated from the colloid, suitable for making the latter give a tenacious film? (The film is required transparent, tough, insoluble in water and unaffected by moderate heat, conditions which the enclosed specimen possesses, but for the objections in its preparation and the expense). (3) Can you give me a cheap method of destroying the smell of methylated spirit? (4) Is there any substance that will render gelatine insoluble in clear, transparent sheets besides the bichromates of ammonia and potash and alum?—Bichromate.

ANSWERS TO CORRESPONDENTS.

NOTICE.—The American Publishers of The Chemical News *give notice that, in accordance with a suggestion of* Mr. Crookes, *the Editor and Proprietor of the English Publication, they will be pleased to receive and forward to him in London any scientific publications issued in America, for review—and also any Notes and Queries, Articles, Correspondence, etc., for publication or reply. Their facilities of communication with* Mr. Crookes *render this very desirable to all persons in the United States who wish to confer with him. Address to him, care of*

W. A. TOWNSEND & ADAMS,
434 Broome Street, New York.

Kalium.—Perchloric acid is in very small demand. The demand for permanganate of potassium is considerable: Messrs. Condy and Co., Battersea, are the principal makers.

J. W. S. and others.—We shall be glad if you will forward replies for "Notes and Queries" in such a form that they can be printed in the Journal. We do not wish a query publicly made to be privately answered.

Jones Power.—A work on the subject by the Editor is in the press.

Professor Charles A. Cameron; Dr. A. W. Hofmann, F.R.S.; H. N. Draper; Dr. Moore; John Pattinson, F.C.S., are thanked for their communications, which shall receive early attention.

T. Y.—Consult the Index; you will find communications on the subjects you name.

C. B. H.—H. Baillière, of 219, Regent Street, or any foreign bookseller.

Capt. W. A. Ross, R.A.—In our issue of December 3rd, 1869 (*Am. Repr., Feb.*, '70, *page* 116), we expressed our regret at not having space for your articles. The great demand on our space obliges us to omit articles which appear to be of but little interest to our readers.

A. Freire-Marreco.—When the papers are of great length we should prefer a condensed report, but when important we will always endeavour to insert them unabridged.

Prof. J. Lawrence Smith.—The receipt of your letter was acknowledged in our columns, and your request has been attended to by our publisher.

Inquirer.—The unabridged edition of "Fresenius" is evidently the best.

M.R.C.S.—Calley's "Practical Telegraphy" will answer your purpose well.

C. R. Stevens.—A work on Dyeing, by the Editor of this paper, is in the press.

C. A. Grant.—(1) We do not know the names and addresses of makers of liquid fuel. (2) The Society of Arts, John Street, Adelphi. (3) We have no printed documents; consult *Engineer* or *Engineering*.

A Subscriber.—The subject is not suitable for our Notes and Queries column; you had better advertise for the information.

The report of the Chemical Section of the Glasgow Philosophical Society arrived too late for insertion in this week's number.

B. Silliman.—Received with thanks.

Metallurgist.—Copper should be perfectly pure; any alloy injures its conductivity.

Prof. C. F. Chandler.—Received with thanks.

Books Received.—"General-Versammlung der Deutschen Chemischen Gesellschaft zu Berlin am December 11th, 1869." From Dr. A. W. Hofmann, F.R.S. "Annual Report of the Progress of Pharmacy." "Transactions of the Newcastle Chemical Society." "On the Absorptive Power of Soil," by Robert Warington, F.C.S.; reprinted from "Practice with Science," vol. II., 1869. "The Food Journal" for March. "The Sugar-Cane" for March. "On the Influence of Mental Activity on the Excretion of Phosphoric Acid by the Kidneys," by Luther Hodges Wood, Ph.B., M.D. "Midland Steam Boiler Inspection and Assurance Company: Chief Engineer's Report, with Records of Boiler Explosions, 1869. "Catalogue of Chemical Manufacturers' Machinery, Plant, &c.," as made by Robert Daglish and Co., St. Helen's Foundry, Lancashire: 1870: red cloth. "The Week of Creation, or the Cosmogony of Genesis considered in its Relation to Modern Science," by George Warington. London: Macmillan and Co. "The Fuel of the Sun," by W. Mattieu Williams, F.C.S. London: Simpkin, Marshall, and Co.

AMERICAN SUPPLEMENT.

New York, May, 1870.

Poisonous Cosmetics.

In December last, Dr. Lewis A. Sayre enclosed to Dr. Harris, Sanitary Superintendent of the Metropolitan District, a pamphlet, in which he described three cases of lead palsy produced by Laird's Bloom of Youth. This communication was laid before the Board of Health, together with notes from Dr. Harris and Sanitary Inspector Dr. Janes, in which attention was called to the great variety and large quantities of poisonous hair dyes, commonly called hair restoratives, etc., consisting essentially of acetate of lead, and enamels consisting of carbonate of lead, which were sold in the Metropolitan District.

The Board at once directed the Chemist to investigate the subject, and his report, which is here presented, fully confirms the opinions of the physicians. It was found, however, in the course of the investigation, that Laird's Bloom of Youth, the original cause of the investigation, no longer consisted of carbonate of lead, but was composed of oxide of zinc. As soon as this was established by the report, the proprietor, who had admitted to the writer that his preparation had formerly consisted of a lead compound, complained with an air of injured innocence that the Board of Health *had inflicted a great wrong upon him, had almost ruined his business.* Articles have been inserted in the daily papers, in the interest of the Bloom of Youth, which reflect upon the Chemist to the Board, as though he had wantonly, or by mistake, attacked an innocent citizen, and interfered with an honest business. We hold that inasmuch as the Bloom of Youth has been for years composed of carbonate of lead, and we know this of our own knowledge, as a bottle was purchased about two years ago, at a drug store on Broadway, and tested at the School of Mines, which had this composition, and as, according to Dr. Sayre and Dr. Hammond, this preparation had produced lead palsy, the proprietor of the article has no just claim for sympathy, even though he has finally, after so much harm has been done, changed its poisonous character.

REPORT OF PROF. C. F. CHANDLER TO THE METROPOLITAN BOARD OF HEALTH.

Col. Emmons Clark,
Secretary Metropolitan Board of Health.

Sir:—In response to the resolution of the Board, directing "the Chemist to examine the various hair tonics, washes, cosmetics, and other toilet preparations in general use, and to report what ingredients, if any, they contain of a character injurious or dangerous to those who use them," I beg leave to submit the following report of the results thus far reached. My examination has been specially directed to the mineral poisons; no tests have been as yet made for vegetable or animal substances, as, for example, cantharides, which I have reason to believe is sometimes employed.

The articles which I have examined may be classed as—

I. Hair tonics, washes, and restoratives.
II. Lotions for the skin.
III. Enamels.
IV. White powders for the skin.

I. Hair Tonics, Washes, and Restoratives.

Of these sixteen have been examined, and, with but one exception, all have been found to contain lead, generally in the form of acetate or sugar of lead.

1. *Hyt's Hiawatha Hair Restorative.* David Wright, Proprietor, 112 South street, New York.

This is an ammoniacal solution of nitrate of silver, containing 4·78 grains of the nitrate in one fluid ounce. It contains no other metals.

2. *Clark's Distilled Restorative for the Hair.* C. G. Clark & Co., Proprietors.

This preparation contains in one fluid ounce:
Lead in solution..... 0·11 grains.

3. *Chevalier's Life for the Hair.* Prepared by S. A. Chevalier, M.D., 1123 Broadway, New York.

One fluid ounce contains:
Lead in solution..... 0·22 grains.
Lead in the sediment..... 0·80 "
Total lead..... 1·02 "

4. *Pearson & Co.'s Circassian Hair Rejuvenator.* J. S. Pearson & Co., 286 Jay street, Brooklyn, N. Y.

One fluid ounce contains:
Lead in solution..... 1·40 grains.
Lead in the sediment..... 1·31 "
Total lead ..... 2·71 "

5. *Ayer's Hair Vigor.* Prepared by J. C. Ayer & Co., Lowell, Mass.

One fluid ounce contains:
Lead in solution..... 2·81 grains.
Lead in the sediment..... 0·08 "
Total lead..... 2·89 "

6. *Prof. Wood's Hair Restorative.* O. J. Wood & Co., 444 Broadway, New York.

One fluid ounce contains:
Lead in solution..... 2·93 grains.
Lead in the sediment..... 0·15 "
Total lead..... 3·08 "

7. *The Hair Restorer of America.* Prepared by Dr. J. J. O'Brien, 202 East 30th street, New York.

One fluid ounce contains:
Lead in solution..... 3·28 grains.

8. *Gray's Celebrated Hair Restorative.* Day, Hoagland & Stiger, 54 Courtlandt street, New York.

One fluid ounce contains:
Lead in solution..... a trace.
Lead in the sediment..... 3·39 grains.
Total lead..... 3·39 "

9. *Phalon's Vitalia.* Prepared by Phalon & Son, 517 Broadway, New York.

Consists of two fluids in separate bottles.

No 1 is a clear, pale yellow solution of hyposulphite of soda.

No. 2 is a clear, pale pink solution, containing in one fluid ounce:
Lead..... 14·08 grains.

As, by the directions which accompany the package, the lead solution is to be diluted with twice its volume of the hyposulphite solution, the strength of the mixture would be reduced to one-third, when it would contain 4·69 grains of lead in one fluid ounce. Prof. Lawrence Reid, the manufacturers' chemist, claims that the hyposulphite of soda renders the lead harmless by ultimately forming with it an insoluble sulphide of lead, and in various other ways. But after carefully considering all his arguments, I am compelled to say that I cannot accept them as valid.

10. *Ring's Vegetable Ambrosia.* E. M. Tubbs & Co., Proprietors, Peterboro, N. H.

One fluid ounce contains:

Lead in the solution	4·69 grains.
Lead in the sediment	0·31 "
Total lead	5·00 "

11. *Mrs. S. A. Allen's World's Hair Restorer.* 198 and 200 Greenwich street, New York, and 266 High Holborn, London, England.

One fluid ounce contains:

Lead in solution	5·26 grains.
Lead in the sediment	0·31 "
Total lead	5·57 "

12. *L. Knittel's Indian Hair Tonique.* Louis Knittel, 616 Eighth avenue, New York.

One fluid ounce contains:

Lead in solution	5·16 grains.
Lead in the sediment	1·13 "
Total lead	6·29 "

13. *Hall's Vegetable Sicilian Hair Renewer.* R. P. Hall & Co., Nashua, N. H.

One fluid ounce contains:

Lead in solution	6·45 grains.
Lead in the sediment	0·68 "
Total lead	7·13 "

14. *Dr. Tebbett's Physiological Hair Regenerator.* Tebbett Bros., Proprietors, Manchester, N. H.

One fluid ounce contains:

Lead in solution	6·82 grains.
Lead in the sediment	0·62 "
Total lead	7·44 "

15. *Martha Washington's Hair Restorative.* Prepared by Simonds & Co., Fitzwilliam, N. H.

One fluid ounce contains:

Lead in solution	3·01 grains.
Lead in the sediment	6·79 "
Total lead	9·80 "

16. *Singer's Hair Restorative.* Depot, 643 Broadway, and 79 Nassau street, New York.

One fluid ounce contains:

Lead in solution	0·15 grains.
Lead in the sediment	16·24 "
Total lead	16·39 "

Recapitulation.—Only one of this class of preparations is free from lead, which metal seems indeed to be the *essential constituent* in most cases. Most of the sediments observed in the bottles, and which require that the bottle "*be well shaken,*" etc., consist of sulphur, which it is intended shall ultimately unite with the lead to produce the dark-colored sulphide of lead, or, as one of the manufacturers has it, "*the original youthful beauty and color.*" The following tabular statement shows how the poisonous hair nostrums compare among themselves:—

Grains of Lead in one fluid ounce.

1. Clark's Distilled Restorative for the Hair	0·11
2. Chevalier's Life for the Hair	1·02
3. Circassian Hair Rejuvenator	2·71
4. Ayer's Hair Vigor	2·89
5. Prof. Wood's Hair Restorative	3·08
6. Dr. J. J. O'Brien's Hair Restorer of America	3·28
7. Gray's Celebrated Hair Restorative	3·39
8. Phalon's Vitalia	4·69
9. Ring's Vegetable Ambrosia	5·00
10. Mrs. S. A. Allen's World's Hair Restorer	5·57
11. L. Knittel's Indian Hair Tonique	6·29
12. Hall's Vegetable Sicilian Hair Renewer	7·13
13. Dr. Tebbett's Physiological Hair Regenerator	7·44
14. Martha Washington Hair Restorative	9·80
15. Singer's Hair Restorative	16·39

II. Lotions or Washes for the Complexion.

1. *Burnett's Kalliston.* Joseph Burnett & Co., Boston, Mass. Contains no injurious metals.

2. *Phalon's Paphian Lotion, or Floral Beautifier.* Phalon & Son, 517 Broadway, New York. Contains no injurious metals.

3. *Enamel of America.* François Gregoire & Co., cor. of Eighth and Locust streets, Phila. A clear colorless liquid, containing no injurious metals.

4. *Email de Paris, de Jared.* Jared et Renf, Paris. A pink alcoholic liquid, free from injurious metals.

5. *Balm of a Thousand Flowers.* A thick yellow emulsion, free from injurious metals.

6. *Perry's Moth and Freckle Lotion.* Dr. B. C. Perry, 49 Bond street, New York.

A colorless liquid, with a little white sediment.

One fluid ounce contains:

Mercury in solution	2·67 grains.
Zinc " "	0·99 "

Equivalent to—

Corrosive sublimate	3·61 "
Sulphate of zinc (crystallized)	4·25 "

The sediment contains a little mercury, lead, and bismuth.

Recapitulation.—With the exception of Perry's Moth and Freckle Lotion, these lotions are entirely free from lead or other injurious metals.

III. Enamels for the Skin.

1. *Balm of White Lilies, for preserving and beautifying the skin.* H. A. Hoadley, New York.

Water colored pink, and holding in suspension a large amount of carbonate of lime. It does not contain any injurious metals.

2. *Dr. Bradford's Enameline for the Complexion.*

A colorless liquid, holding 33·02 grains of oxide of zinc in suspension in each fluid ounce. Is free from lead.

3. *Hagan's Magnolia Balm.* Demas Barnes & Co., New York.

A colorless liquid, holding in suspension in each fluid ounce 118·61 grains of oxide of zinc. Is free from lead.

4. *Laird's Bloom of Youth, or Liquid Pearl.* Geo. W. Laird, 74 Fulton street, New York.

A colorless liquid, holding in suspension in each fluid ounce 169 grains of oxide of zinc. It is entirely free from lead.

5. *Eugénie's Favorite.* M'lles T. & L. Jouvin, late of Rue St. Anne, Paris.

A colorless solution, holding in suspension in each fluid ounce 140·52 grains of carbonate of lead, *white lead*, containing 108·94 grains of metallic lead. There is a trace of lead dissolved in the liquid.

6. *Snow-white Enamel for Whitening and Beautifying the Complexion.* Phalon & Sons, 517 Broadway, New York.

A colorless liquid, holding in suspension in each fluid ounce 186·67 grains of carbonate of lead, equivalent to

Metallic lead in sediment.....	144·72	grains.
Lead in solution.....	1·56	"
Total lead.....	146·28	"

7. *Snow-white Oriental Cream, for Whitening and Beautifying the Complexion.* Phalon & Sons, 517 Broadway, New York.

A colorless liquid, holding in suspension in each fluid ounce 246 grains of carbonate of lead; equivalent to

Lead in suspension.....	190·22	grains.
Lead in solution.....	0·77	"
Total lead.....	190·99	"

Recapitulation.—The Enamels consist of white powders suspended in clear liquids; on standing the powders subside, but agitation quickly incorporates them with the liquids again. The following contain lead, mostly, if not entirely, in the form of *carbonate;* they are therefore simply "white lead" ground in water.

Grains of Lead in one fluid ounce, after shaking.

Eugénie's Favorite	108·94	grains.
Phalon's Snow-white Enamel.....	146·28	"
Phalon's Snow-white Oriental Cream..	190·99	"

IV. White Powders for the Skin.

1. *John Irvine's Compound Chinese Tablet of Alabaster* consists of carbonate of lime, free from injurious metals.

2. *Shand's Compound Chinese Tablet of Alabaster* consists of carbonate of lime, free from injurious metals.

3. *Superior Lily White,* X. Bazin, Philadelphia, consists of carbonate of lime and carbonate of magnesia, free from injurious metals.

4. *Cascarilla de Caracol de Persia,* R. & C. A. Wright, Philadelphia, consists of carbonate of lime, and some earthy matter insoluble in acids, either clay or "French chalk;" is free from injurious metals.

5. *The Original Tablet of Alabaster, or Lily White Cosmetic,* consists of carbonate of lime, with some clay or "French chalk;" is free from injurious metals.

6. *Bismuth Powder for Beautifying the Skin and removing Freckles* consists of carbonate of lime, with much clay or "French chalk;" is free from injurious metals.

7. *Lavel's Lily White and Rose Bloom* consists of clay or "French chalk;" is free from injurious metals.

Recapitulation.—The white powders consist of carbonate of lime, carbonate of magnesia, clay, or "French chalk;" either singly or mixed. Nothing injurious was detected in any one of them.

Conclusion.—It appears from the foregoing:—

1. The Hair Tonics, Washes, and Restoratives contain lead in considerable quantities; that they owe their action to this metal, and that they are consequently highly dangerous to the health of persons using them.

2. With a single exception, Perry's Moth and Freckle Lotion, which contains corrosive sublimate, the Lotions for the skin are free from lead and other injurious metals.

3. That the Enamels are composed of either carbonate of lime, oxide of zinc, or carbonate of lead, suspended in water. The first two classes of enamels are comparatively harmless, as harmless as any other white dirt when plastered over the skin to close the pores and prevent its healthy action. On the other hand, the enamels composed of carbonate of lead are highly dangerous, and their use is very certain to produce disastrous results to those who patronize them.

4. The white powders for the skin are harmless, except in so far as their application may interfere with the healthy action of the skin.

Respectfully submitted,
C. F. Chandler, Ph.D.,
Chemist to the Metropolitan Board of Health.

The Various Methods for the Determination and Separation of Baryta, Strontia, and Lime.

BY PAUL SCHWEITZER, PH.D.

(Continued from the April Number.)

III. *Determination of Lime.*

Lime is generally precipitated from its solutions as sulphate, carbonate, or oxalate of lime, and weighed as either sulphate, carbonate, or caustic lime. In the latter case, five minutes over a good blast-lamp will generally be sufficient to free each decigramme of lime from all carbonic acid; a second test will, however, always be necessary. Several treatises on this and other related subjects have lately been published, of which I will mention J. Fritzsche, Zeitschrift für Analytische Chemie, 3 Jahrgang, p. 177; and Alfonso Cossa, the same Zeitschrift, 8 Jahrgang, p. 141, whose results show the comparative value of some of the determinations of lime and the modes of best applying them. From the character of the relation existing between the three alkaline earths we may infer beforehand that the precautions to be observed in the precipitation and determination of baryta and strontia have to be also observed with lime. The same affinities exist between its salts and those of the alkalies, though somewhat modified; for while baryta and strontia, principally in combination with strong acids, combine with and retain alkaline salts, the latter are taken up to a much larger extent by salts of lime, in combination with a weak acid. This affinity of the three alkaline earths to salts of alkalies extends to other oxides also, and is the probable cause of the non-metamorphic crystalline as well as massive deposits of lime containing always some, and often a considerable amount of impurities. These impurities we find also in the metamorphosed

gypsum; while the sulphates of baryta and strontia, which are precipitated directly from their solutions, are comparatively much purer. All three alkaline earths can exist, under certain conditions, in solution with alkaline carbonates and sulphates. These conditions being removed, as for example in the case of a spring reaching the surface of the earth, heat and pressure disappear, the sulphate of baryta is precipitated directly, with little or no impurities (sulphate of strontia), while strontia and lime salts are carried off. Soon the bicarbonate of strontia loses carbonic acid, and, in case sulphates are present, is precipitated as sulphate of strontia with the last traces of baryta, and, depending on the basin, in which this deposition occurs and the nature of its outlets, with or without sulphate of lime. In the absence of alkaline sulphates, carbonate of strontia will be deposited invariably with carbonate of lime; while the dissolved carbonate of lime, as it flows from a deposit of sulphate or carbonate of strontia, will either be totally free from or contain carbonate of strontia. These generalizations would lead me too far, but deductions drawn from the consideration of the small amounts of impurities, as they exist in all well-characterized minerals, seem to me to promise valuable results, especially as regards geology.

For the following determinations a pure carbonate of lime was used, that showed before the spectroscope no traces of other alkaline earths nor of the alkalies. It was weighed as caustic lime, and the weight given as carbonate, in order to be in accord with the other determinations. It was proved by experiment that the weight of carbonate of lime represented the exact amount taken.

Sulphate of Lime.

The caustic lime was dissolved in a platinum dish in hydrochloric acid, and the solution evaporated on a water-bath, until acid fumes could be no longer detected. This solution was then transferred to a beaker glass and diluted to the proper volume, after which a sufficient amount of dilute sulphuric acid and twice the volume of alcohol was added. After standing for about two days, the voluminous precipitate of hydrous sulphate of lime was filtered on a weighed filter, and washed with alcohol until neither hydrochloric nor sulphuric acid could be detected in the filtrate. Even then, as in the case of baryta and strontia, it contained traces of free sulphuric acid, which was proved by the carbonization of parts of the filter-paper on subsequent drying. The precipitate was then dried over sulphuric acid, and finally in an air-bath, with a view to a possible indirect determination of lime and one other alkaline earth, before it was ignited in the usual way. Two determinations were made in this way with the following result:—

A 1·2639 CaO,CO^2	B. 1·2750 CaO,CO^2
yielded 1·7086 CaO,SO^3	yielded 1·7236 CaO,SO^3
= 1·2564 CaO,CO^2	= 1·2674 CaO,CO^2
= 99·41 p. c.	= 99·40 p. c.
— 0·59 p. c.	— 0·60 p. c.

The loss on drying was—1. after standing for seven days over sulphuric acid; 2. after two days longer; 3. after three hours in an air-bath at 212° F.; and 4. after four hours in the same bath; or rather the amount of water retained was the following:—

A. 21·55 p.c.	B. 21·99 p.c.
21·02 p.c.	21·90 p.c.
5·29 p.c.	12·19 p.c.
5·03 p.c	11·33 p.c.

The formula $CaO.SO_3 + 2HO$ requires 20·93 p.c. of water. The precipitate of sulphate of lime will be reduced in volume by long standing, and washes out remarkably easily and quickly. The extent of its solubility in hydrochloric acid is sufficiently well known, and for this reason and its solubility in water alone, no analysis could be made to determine the amount of alkaline salts taken up. That alkaline salts, however, are taken up by sulphate of lime was determined in another way, namely, by precipitating, with all the precautions necessary, a solution of sulphate of potassa with chloride of calcium, and the addition of alcohol. In the two following analyses the alcohol was added to A, directly after the addition of the sulphuric acid, while B was allowed to stand for twenty-four hours before it was mixed with alcohol. The precipitates obtained in this way were totally different, as might have been expected. For while nothing precipitated at first, the gypsum commenced to crystallize out of B, so that the addition of alcohol afterwards produced only a slight cloudiness. It had then an apparent volume of one-half of that of A, could be filtered and washed quicker than A, and represented after ignition a light crystalline powder, not less in volume than the original, the crystalline form of which could be easily determined with the aid of a microscope. The amount of alkali taken up differs with the mode in which the gypsum has been produced, showing clearly that a certain length of time is necessary to effect the decomposition of one salt in solution by another. As additional examples I will mention the precipitation of very small amounts of sulphuric acid by a salt of baryta and other phenomena of this class, the gradual precipitation of carbonate of an alkaline earth from a solution of such carbonate in hydrochloric acid by ammonia and others.

The results are as follows:—

A. 1·0550 $KO.SO^3$	B. 1·0575 $KO.SO^3$
yielded 0·8263 $CaO.SO^3$	yielded 0·8241 $CaO.SO^3$
= 1·0585 $KO.SO^3$	= 1·0557 $KO.SO^3$
= 100·33 p.c.	= 99·83 p.c.
+ 0·33 p.c.	— 0·17 p.c.

Carbonate of Lime.

Carbonate of ammonia produces in solutions of lime a white, flocculent precipitate, which by boiling changes into a heavy, crystalline powder, which can be easily and quickly washed. It resembles in this respect carbonate of strontia, just as much as the sulphates resemble each other, both differing from the corresponding baryta salts. In the presence of alkaline salts, those are precipitated to some extent, and by washing such precipitate until no hydrochloric acid is found in the filtrate, make about two per cent. in addition. For the following three analyses, A and B without, C with, the addition of 6 grammes alkaline chlorides, the lime was dissolved in hydrochloric acid, ammonia added to alkaline reaction, and the boiling solution precipitated with carbonate of ammonia. The carbonate of lime may be dried and weighed as described under strontia; for though it is asserted that even a very low heat will drive out some carbonic acid, I could not satisfy myself as to the fact. The test with turmeric paper I applied myself several times to such dried precipitate, without being able to detect any difference between this and well-washed and pure air-dried carbonate of lime. The results of the analyses also prove the accuracy of the method. In the presence of alkaline car-

bonates, drying will, in the same way, show a higher percentage than the determination as caustic lime or sulphate of lime; but the results will be lower, and the difference amounts to exactly the weight of carbonic acid that corresponds to the alkali retained. Whether this is accidental, or whether the carbonate of lime loses at that temperature, and under the influence of the alkaline carbonate in combination with it or distributed through its whole mass, an equivalent portion of carbonic acid, I cannot yet decide. Certain it is that repeated heating in this way does not alter the first weight obtained. The results are as follows: 1. representing the weight after drying; 2. after heating for 15 minutes over the blast lamp; and 3. after 25 minutes' heating over the blast lamp:—

	A.	B.	C.
$CaO.CO^2$	1·1129 gr.	0·8181	1·1794
CaO	=0·6227 gr.	=0·4576	=0·6746
$CaO.CO^2$	=1·1120	=0·8173	=1·2046
	= 99·92 p.c.	= 99·90	=102·14 p.c.
	— 0·08 p.c.	— 0·10	+ 2·14 p.c.
1) $CaO.CO^2$	1·1111	0·8166	1·1975
	99·84 p.c.	99·82 p.c.	101·53 p.c.
2) CaO	0·6235		0·6755
$CaO.CO^2$	1·1134		1·2062
	100·13 p.c		102·28
3)	99·92 p.c.	99·90 p.c.	102·14

Oxalate of Lime.

The precipitation of lime as oxalate is in most cases resorted to, and gives results that are not surpassed in accuracy by any other method. The precipitated oxalate is best weighed as caustic lime wherever a good blast-lamp can be had, otherwise it is less troublesome to convert it into sulphate. It is a very tedious process to reconvert the ignited oxalate into carbonate, as was done with B. The amount of alkalies retained is very large; in the analysis of ores, therefore, that are subjected to a process of fusion with carbonate and nitrate of potassa or soda, the precipitated oxalate of lime must be dissolved once more in acid and re-precipitated, even in the absence of all magnesia. A and B were precipitated without, C after, the addition of 6 grammes alkaline chlorides. The results are as follows:

A. 1·8057 $CaO.CO^2$	B. 0·9415 $CaO.CO^2$	C. 1·6126 $CaO.CO^2$
2·4561 $CaO.SO^3$		2·2840 $CaO.SO^3$
1·8060 $CaO.CO^2$	0·9424 $CaO.CO^2$	1·6800 $CaO.CO^2$
100·02 p.c.	100·09 p.c.	104·18 p.c.
+ 0·02 p.c.	+ 0·09 p.c.	+ 4·18 p.c.

The precipitation of salts of strontia by chromate of potassa proves this method to be worthless as a means of separating it from baryta. A concentrated solution of chloride of calcium, as prepared according to Fresenius' qualitative analysis, will also have a precipitate of chromate of lime appearing after a few days, the amount of which was, however, not determined. As this finishes all the different modes of determining the three alkaline earths, I will take up in the next paper the modes of separating one from the other.

Bullion Product of the United States for 1869.

Rossiter W. Raymond, Ph.D., U. S. Commissioner of Mining, estimates the bullion product for 1869 as follows:—

California	$20,000,000
Nevada	14,000,000
Oregon and Washington	4,000,000
Idaho	7,000,000
Montana	12,000,000
Colorado and Wyoming	4,000,000
New Mexico	500,000
Arizona	1,000,000
All other sources	1,000,000
Total	$63,500,000

Commercial Test of Cotton-Seed Foots.

BY DR. I. WALZ.

The residues from the clarification of cotton-seed oil, the so-called "foots," are now quite generally used as "stock" in the manufacture of various kinds of soap, and I have lately had frequent occasion to test them for their commercial value in this connection. In this way I have become acquainted with an interesting difference between the "foots" obtained by the use of soda and of potash, both of which, however, contain substantially the same components, viz.: fatty acids, albumen, mucilage, alkali, and impurities.

I test the sodic foots in the following simple manner: 15 grammes or half an ounce of the material are boiled with 35 c.c. of water, to which a few drops of caustic soda are added in order to facilitate the solution. This being effected, 5 c.c. of strong hydrochloric acid are added, and the whole is poured into a burette which is kept for this special purpose. After the complete separation of the fatty acids from the liquid has taken place, the quantity of the former is read off in cubic centimetres, and compared with a sample of standard stock of known value which has been treated in the same manner.

The burette which I use for this purpose is so graduated that, using the quantities above given, every cubic centimetre of fatty acid indicates a value of ¼ cent in the pound of stock; so that an article, 15 grammes of which yield 12 c.c. of fatty acid, is worth 3 cents per pound.

At first I attempted to test the potassic foots in the same manner, but I found that the fatty stratum in this case generally measured 50–75 per cent. more for the same amount of material than for the soda stock,—a result which I knew could not possibly be correct. Its appearance also was never homogeneous, but, especially near the dividing line, indicated the presence of lumps of coagulated albumen. I succeeded, however, in obtaining perfectly concordant results by proceeding as follows: 15 grammes of the foots are boiled with 40 c.c. of water containing some caustic soda, and salt enough is then added to form a soda soap. The whole is allowed to stand 15–20 minutes, after which the soda soap will be found floating on the top of the lye. The latter is then carefully drawn off by means of a syphon, and the test of the residue proceeded with as above directed.

An Experiment to Demonstrate Increase of Weight in Combustion.

I notice in the February Number of the Chemical News, "An experiment to demonstrate increase of weight in combustion."

Believing that the method which I have been in the habit of employing to illustrate the same fact is superior to that described in the article referred to, I take the liberty to send it in, and, if you think it worth the space it will occupy, please insert it in the NEWS. The experiment is as follows: Take a small quantity (say 5 or 6 grammes) of "Iron by Hydrogen" in a *thin* iron dish (a very small sand-bath), place it on the balance pan and counterpoise with weights. The fine iron can be lighted very easily with a match, and as it burns quietly the scale-pan will gradually descend, showing very clearly the increase in weight by oxidation.

D. H. BRIGGS.

Norton, Mass., March 26, 1870.

Adulterated Aniline Dyes.

TO THE EDITOR OF AMERICAN SUPPLEMENT TO CHEMICAL NEWS:

I HAVE recently found a curious adulteration in aniline dyes, that may interest some of your readers.

It consists of fine granulated sugar, and each particle or crystal is so well covered with a thin film of the true aniline dye as to produce a very good imitation, in color and form.

The first instance was a case of sixty pounds of Hoffmann's Violet, which was sold for about six dollars per pound, without discovery. It contained more than half its weight of this colored sugar, the remainder being ordinary crystals of aniline violet.

These dyes have not been heretofore so extensively adulterated, and although this fraud may be easily detected, still it is a dangerous one, and one against which dyers and colorers should be cautioned.

S. DANA HAYES,
State Assayer, Mass.

Boston, Mass., April 21st, 1870.

Statistics of the Sugar Industry.

THE following interesting tables are extracted from the admirable report on the *État de l'Industrie du Sucre*, by M. B. Dureau, editor of the *Journal des Fabricants de Sucre*. It was one of the Jury Reports of the Exposition Universelle of 1867.

Production of Beet Sugar in France, 1866–67.

DEPARTMENT.	No. of Factories.	Kilogrammes.	Pounds.	Per Cent.
Aisne	80	39,172,464	86,360,398	18·06
Nord	160	77,922,287	171,789,032	35·93
Oise	32	16,813,646	37,067,700	7·75
Pas-de-Calais	76	35,446,974	78,147,208	16·34
Somme	55	24,731,431	54,523,407	11·41
Other departments	38	22,767,875	54,194,512	10·51
Total	441	216,854,677	482,082,257	100·00

Total Production of Beet Sugar in 1866.

	Kilogrammes.	Pounds.	Per Cent.
France	216,850,000	478,071,847	32·14
Zollverein	192,500,000	424,389,350	28·53
Russia	100,000,000	220,462,000	14·83
Austria	100,000,000	220,462,000	14·83
Belgium	40,000,000	88,184,800	5·92
Poland	19,000,000	41,887,780	2·81
Holland	6,000,000	13,227,720	0·89
	674,350,000	1,486,685,497	100·00

Total Production of Sugar in 1867.

	Kilogrammes.	Pounds.	Per Cent.
Cuba (exportation)	530,000,000	1,168,448,600	22·72
Porto Rico (exportation)	60,000,000	132,277,200	2·57
Antilles, Eng., Danish Guiana	250,000,000	551,155,000	10·72
French Colonies	150,000,000	330,693,000	6·43
Louisiana	30,000,000	66,138,600	1·28
Mexico	32,000,000	70,547,840	1·37
Peru (exportation)	1,000,000	2,204,620	0·04
Brazil	130,000,000	286,600,600	5·57
Sandwich Islands	10,000,000	22,046,200	0·42
Spain	5,600,000	12,345,872	0·24
Port Natal	6,000,000	13,227,720	0·25
Queensland	500,000	1,102,310	0·02
China	14,200,000	31,305,604	0·61
Penang (exportation)	3,000,000	6,613,860	0·12
Siam	5,200,000	11,464,024	0·22
Java	130,000,000	286,600,600	5·57
East Indies (exportation)	24,000,000	52,909,880	1·03
Mauritius	100,000,000	220,462,000	4·29
Manilla (exportation)	60,000,000	132,277,200	2·57
Egypt (exportation)	10,000,000	22,046,200	0·43
Cane Sugar	1,551,500,000	3,420,467,930	66·47
Beet Sugar, Europe	650,000,000	1,433,003,000	27·87
Palm or Date Sugar	100,000,000	220,462,000	4·29
Maple Sugar, N. America	30,000,000	66,138,600	1·28
Total Sugar	2,331,500,000	5,140,071,530	100·00
Sorghum Syrup—gallons	18,000,000		

Recent Chemical Patents.

Issued March 22, 1870.

100,961.—Electro-Deposition of Metals.—Isaac Adams, Jr., Boston, Mass.

100,997.—Removing Colors from Leather.—E. S. Frye, Salem, Mass.

101,003.—Restoring Waste Alkali Used in Oil Refineries.—Wm. Goodain and Geo. Stead, Cleveland, Ohio.

101,009.—Extracting Copper from its Ores.—Nathaniel Haskell, San Francisco, Cal.

101,011.—Apparatus for Producing Sulphurous Acid.—Moritz Hatschek, Pesth, Hungary.

101,012.—Process and Apparatus for Treating Wood.—Ira Hayford, Boston, Mass.

101,019.—Apparatus for Cooling and Saving Charcoal.—G. A. Jasper, Charlestown, Mass.

101,038.—Treating Coal-Products to Obtain Benzole, etc.—John Rowley, Camberwell, England.

101,067.—Manufacture of Iron, and Apparatus therefor.—James Davenport Whelpley and Jacob Jones Storer, Boston, Mass.

101,075.—Electroplating Apparatus.—H. W. Wright, Taunton, Mass.

101,131.—Fertilizer.—H. A. Hogel, Brooklyn, N. Y.

101,193.—Manufacture of Soap.—Alexander Warfield, Alexandria, Va.

101,198.—Ice Machine.—Frank Windhausen, Brunswick, Germany.

Issued March 29, 1870.

101,213.—Apparatus for Tanning Leather.—O. W. Bean and W. B. Rowland, Tecumseh, Mich.

101,243.—Tanning.—Elihu England, Mossy Creek, Tenn.

101,248.—Preventing the Incrustation of Steam-Boilers.—J. T. Fisher, Pittsburg, Pa.

101,250.—Converting Articles made of Iron into Steel.—Hiram C. Folsom, Bangor, Me.

101,253.—Manufacture of Artificial Stone.—Aaron H. Frear, Chicago, Ill.

101,263.—Manufacture of Iron and Steel.—James Henderson, New York City.

101,264.—Tinning and Galvanizing Wire.—E. H. Hill, Worcester, Mass.

101,283.—Bleaching Dark Soap and "Foots."—Oscar Loew, N. Y. City.

101,284.—Method of Bleaching and Refining Oils.—Oscar Loew, N. Y. City.

101,291.—Manufacture of Cast Steel.—Hugh McDonald, Pittsburg, Pa.

101,319.—Process of Obtaining Acetic Acid from Wood.—Theodore Schwartz, N. Y. City.

101,320.—Treating Wood to Obtain Useful Products.—Theodore Schwartz, N. Y. City.

101,331.—Apparatus for Tanning Hides.—R. T. White, Winchester, Mass.

101,406.—Process of Preparing Paper for Roofing and Similar Purposes.—C. H. Smith, Baltimore, Md.

Issued April 5, 1870.

101,415.—Apparatus for Generating Carbonic Acid.—Benj. Bates, Baltimore, Md.

101,544.—Process and Apparatus for Supplying Pure Water to Buildings.—John A. Thompson, Auburn, N.Y.

101,553.—Process of Treating Wood.—S. P. Wheeler, Bridgeport, Conn.

101,555.—Combined Distilling Apparatus.—Ludwig Wolff, Chicago, Ill.

101,557.—Apparatus for Generating and Carburetting Hydrogen Gas.—J. S. Wood, Phila., Pa.

101,558.—Generating Hydrogen and Hydrocarbon Gas.—J. S. Wood, Phila., Pa.

101,624.—Manufacture of Steel.—O. E. Hunter, Keyport, N.J.

101,625 —Composition for the Manufacture of Friction Matches.—J. J. Karlen, Erlenbach, Switzerland.

101,654.—Desulphurizing Ores.—John F. Osgood, Boston, Mass.

101,661.—Tanning by Infiltration.—L. T. Robertson, N. Y. City.

Issued April 12, 1870.

101,783.—Manufacture of Sugar and Alcohol from Lichens.—Sten Stenberg, Stockholm, Sweden.

101,812.—Apparatus for Tanning by Infiltration.—J. G. Baker, Wilmington, Del.

101,861.—Composition of Matter called "Metaline," for Journals, Bearings, &c.—Stuart Gwynn, New York City. Antedated March 30, 1870.

101,869.—Process of Forming Compositions of Matter called "Metaline," for Journals, Bearings, Steps, and other Articles liable to Friction.—Stuart Gwynn, New York City. Antedated March 30, 1870.

101,876.—Apparatus for the Manufacture of Ice.—D. L. Holden, New Orleans, La.

101,935.—Treating Fatty Matter for the Manufacture of Candles.—Antoine Radisson St. Cyr, Lyons, France.

101,964.—Burning Petroleum and other Hydrocarbon Oils.—L. E. Truesdell, Warren, Mass.

Reissues.

3,884.—Manufacture of Glue.—George Guenther, Chicago, Ill., and E. H. Neymann, N. Y. City.

3,920.—Converting Iron into Steel.—Thomas J. Barron, New York City.—Patent No. 60,823, dated Jan. 1, 1867.

NEW PUBLICATIONS.

THE TRANSACTIONS OF THE AMERICAN INSTITUTE FOR 1868–69 is now ready for distribution. In addition to the usual official reports, it contains the proceedings of the three scientific societies connected with the Institute—the Farmers' Club, the Polytechnic Section, and the Photographical Society. The volume is well edited, and an important feature of it is the admirable summary of scientific news which it contains. This has been prepared from the principal sources of such intelligence, both foreign and domestic.

THE AMERICAN JOURNAL OF SCIENCE FOR MARCH contains the following articles of special interest to chemical readers :—

1. "Photometric Experiments," by Ogden N. Rood.
2. "Contributions to the Chemistry of Copper," by T. Sterry Hunt.
3. "On the Silver Mines of Santa Eulalia, State of Chihuahua, Mexico," by James P. Kimball.
4. "Machinery and Processes of the Industrial Arts, and Apparatus of the Exact Sciences," by Frederick A. P. Barnard,
5. "On Norite and Labradorite Rock," by T. Sterry Hunt.
6. "On the Cause of the Color of the Water of Lake Leman, Geneva," by Aug. A. Hayes.
7. "On the Potassic-Cobaltic Nitrite known as Fischer's Salt, and some Analogous and Related Compounds," by Samuel P. Sadtler, contribution from the Laboratory of the Lawrence Scientific School.

THE ARTS: a new monthly journal of 24 folio pages, devotad to science and arts. Published at Chicago, under the editorship of Joseph M. Hirsh. The first number, for March, 1870, is well printed, and contains some very good articles.

THE METRICAL POCKET-BOOK; OR, MANUAL OF WEIGHTS, MEASURES, AND COINS. By H. Dalmon. Philadelphia; J. B. Lippincott & Co. 12mo, 54 pp.

A very convenient collection of tables for the conversion of weights, measures, and coins from the English to the metrical system, and *vice versâ*; with full explanations for their use. It also contains a list of the more important weights, measures, and coins of several other countries.

CATALOGUE OF THE OFFICERS AND STUDENTS OF THE SCHOOL OF MINES, COLUMBIA COLLEGE.

This department of Columbia College was organized in 1864 and will complete its sixth year in June.

The Faculty includes a president, eight professors, two instructors in modern languages, nine assistants in chemistry, mineralogy, geology, drawing, &c., besides the librarian.

It has already thirty-seven graduates, the majority of whom have secured positions. The students in attendance number seventy-nine.

There are five courses of instruction:—

1. Civil Engineering.
2. Mining Engineering.
3. Metallurgy.
4. Geology and Natural History.
5. Analytical and Applied Chemistry.

The School is well supplied with all the conveniences for instruction: cabinets of minerals, rocks, fossils, specimens illustrating applied chemistry, models of furnaces, machines, descriptive geometry, constructions, laboratories for qualitative and quantitative analysis, assaying, gas-testing, special investigations, etc.

The library already numbers nearly three thousand volumes, and is specially rich in complete sets of scientific journals, as *Dingler's Polytechnic Journal, Annales de Chimie et de Physique, Grün, Gilbert, and Poggendorff's Annalen, Liebig and Wohler's Annalen, American Journal of Science*, and many others. Eighty of the best American and European periodicals are regularly received.

The course of instruction in the School is eminently practical, as one or two examples will show :—

During the first year qualitative analysis is taught by lectures and blackboard exercises, and the student is required to repeat all the experiments at his table in the laboratory. Having acquired a thorough experimental knowledge of the reactions of a group of bases or acids, single members of the group or mixtures are submitted to him for identification. He thus proceeds from simple to complex cases till he is able to determine the composition of the most difficult mixtures. Constant use is made of the spectroscope in these investigations.

When the student shows on written and experimental examination that he is sufficiently familiar with qualitative analysis he is allowed to enter the quantitative laboratory.

During the second and third years quantitative analysis is taught by lectures and blackboard exercises, and the student is required to execute in the laboratory in a satisfactory manner a certain number of analyses. He first analyzes substances of known composition, such as crystallized salts, that the accuracy of his work may be tested by a comparison of his results with the true percentages.

These analyses are repeated till he has acquired sufficient skill to insure accurate results. He is then required to make analyses of more complex substances, such as coals, limestones, ores of copper, iron, zinc, and nickel, pig-iron, slags, technical products, etc., cases in which the accuracy of the work is determined by duplicating the analyses, and by comparing the results of different analysts.

Volumetric methods are employed whenever they are more accurate or more expeditious than the gravimetric methods. In this way each student acquires practical experience in the chemical analysis of the ores and products which he is most likely to meet in practice.

During the third year the student is admitted to the assay laboratory, where he is provided with a suitable table and a set of assay apparatus; and where he has access to crucible and muffle furnaces, and to volumetric apparatus for bullion assay by the wet process. The general principles as well as the special methods of assaying are explained in the lecture-room, and at the same time the ores of the various metals are exhibited and described. The student is then supplied with suitable material, ores of known composition, and is required to make assays himself. He first receives ores of lead,—the sulphuret, carbonate, and phosphate,—which he mixes with the proper fluxes, and heats in the furnace, obtaining a button of lead which he carefully weighs, thus determining the percentage of metal in the ore. He then determines by cupellation the amount of silver in the lead. Silver ores are next given to him—at first those which are most easily assayed, such as the mixtures of chloride of silver with quartz; afterwards more complex ores, such as galena, ruby silver ore, mispickel, fahlerz, etc; these he is required to assay both in the crucible and in the scorifier.

Ores of gold are next supplied,—auriferous quartz, slates, pyrites, blende, etc.,—which are assayed by the most reliable methods.

To facilitate the assay of ores of the precious metals, a system of weights has been introduced, by which the weight of the silver or gold globule obtained in the assay shows at once, without calculation, the number of troy ounces to a ton of ore.* The student then passes on to the assay of silver and gold bullion, the former by Gay-Lussac's volumetric method, the latter by "quartation" or "parting."

Ores of tin, antimony, and iron are then assayed by the dry methods, when the course is completed. Each student thus executes two or three hundred assays himself, under the immediate supervision of the instructor.

Efforts are now being made to combine the School of Mines with the Cooper Institute, which was founded by Peter Cooper for the free education of the working classes in science and art. Such a combination would be of great advantage to both institutions: to the Cooper Institute, in adding to its effective corps of instructors the professors of the School of Mines, and thereby giving to it a higher tone and a larger force; to the School of Mines, in bringing it at once in immediate contact and sympathy with the public, and in securing for it the active interest of those who have made the Cooper Institute such a marked success.

It is not generally known that Columbia College never closes her doors to those who cannot afford to pay the fees. The trustees some years since very liberally resolved "that the President and Treasurer be authorized to remit the fees of any meritorious young man who cannot afford to pay them." No pledges are exacted, and no distinctions are made—in fact, no one knows who the young men are who have been admitted under this resolution.

We wish this young school of practical science the fullest measure of

* Described in the CHEMICAL NEWS, Am. Repr., vol. v., August, 1869, page 113.

success, and believe that it is destined to exert an important influence on the progress of the arts and sciences in this country. It needs, however, all the encouragement New York can give it. Columbia College cannot afford it one-fourth the money necessary to make it what it should be. New York should be the great school for practical science; all that is now required is money. The School of Mines with the Cooper Institute would constitute a grand nucleus; but at least one million dollars additional endowment would be required to make it what it should be. Is there no one of our great capitalists who will come forward and furnish the funds for this grand project?

BREVITIES.

The Lyceum of Natural History of New York.—At the meeting of the Chemical Section of the Lyceum, April 18th, President Newberry in the chair, Mr. O. Loew presented a paper on hydrogen amalgam. The author discovered accidentally that a zinc amalgam left to itself for some time had been partially converted into a spongy mass, which upon investigation proved to be mercury in combination with hydrogen. The compound, however, was of a very unstable nature; but, after many experiments, an amalgam was obtained which presented the semi-solid, spongy appearance of the amalgams. A zinc amalgam, containing about three per cent. of zinc, was vigorously shaken in a small flask with a considerable amount of a concentrated solution of bichloride of platinum. The mass became hot and dark with precipitated platinum. When it was thrown into water and concentrated hydrochloric acid added, a lively evolution of hydrogen ensued, and a bright mass remained which continued to slowly evolve hydrogen. No analysis of this substance was made. The volume of gas evolved amounted to 160 times the volume of the mercury.

Following the reading of this paper, Dr. I. Walz gave his views upon the non-existence of antozone, and Dr. Paul Schweitzer read notices of recent chemical investigations gathered from foreign journals.

Explosion of Phosphorus.—Early on Saturday morning, Feb. 12th, an explosion occurred in the chemical works of Chas. Pfizer and Co. in Brooklyn. One workman was very seriously, another slightly injured, while the damage to the building was considerable. The exact cause of the explosion has not been made public, though it is known to have been caused in some way by phosphorus. The *World* says: "This is the third explosion that has occurred in Brooklyn within a short time, *exclusive of Kerosene-oil explosions, which are of almost daily occurrence.*"

An Agricultural College in Virginia.—Mr. S. Miller, of Lynchburg, Va., has given $100,000 to found an agricultural college. What a pity it is that those who give generously to the cause of education do not know that we have already five times as many Colleges as the population of the country demands, and that $1,000,000 is the smallest sum that it would be expedient to *begin* a new college with. If Mr. Miller had given his $100,000 to some college already established, and by so doing had enabled it to expand by adding something to its scientific departments, he would have done more for the country and the cause of agricultural education than if he had given three times the sum to found a new college. President Barnard, in a recent report to the Trustees of Columbia College, has shown that the two hundred and twenty colleges in the United States have an average attendance of only eighty students each. As the successful colleges have from one to five hundred students each, the others cannot average forty. We want fewer colleges and larger endowments.

Annual Testing of the National Coinage.—Prof. Joseph Henry, of the Smithsonian Institution, and Prof. Thomas Egleston, Jr., of the School of Mines of Columbia College, have been appointed commissioners for the annual trial of the coin of the United States at the Mint in Philadelphia.

Nitroglycerine Explosions.—On March 2d, shortly before noon, a terrible explosion of nitroglycerine occurred on the new Fleetwood race-course at Morrisania. A blast had been inserted in a large rock the day before, but for some unknown reason failed to explode. One of the men, though cautioned to be careful, began striking the rock with his hammer. He did so but a few times when a terrific explosion took place. Immense fragments of rock were thrown to a great height by the force of the explosion, and on the subsiding of the dust and smoke the bodies of eleven men—one dead, and the rest badly injured—were lying around.

On March 17th, Shaffner's nitroglycerine factory on the Hackensack river, in New Jersey, was destroyed by an explosion. Workmen were engaged in carrying bags of nitroglycerine to a sloop lying near by, when one of them fell from the shoulder of one of the men and exploded. This explosion was immediately followed by another, far more terrific, of the nitroglycerine stored in the building. The factory was entirely demolished, four men were killed outright, fragments of their bodies being scattered in every direction. Several other persons were severely injured. The explosion was heard for miles around, and its force broke the windows of houses a mile distant upon the neighboring hills. At the time of the accident there were 7,000 pounds of nitroglycerine in the building. The value of the property destroyed exceeds $75,000. An act had been passed but a few days before, by the New Jersey Legislature, ordering the removal of the manufactory.

Discovery of Salt.—An exchange announces the discovery of salt-fields, as rich in brine as those recently discovered in Goderich, Canada. They are in Sanilac county, Michigan. The lands comprise about three hundred acres, and lie about six miles in and from Lexington, the county seat of Sanilac.

The Lyceum of Natural History.—At the Meeting of the Chemical Section, held March 14th, the following papers were read:—

Dr. Paul Schweitzer. "Notices of Recent Investigations."
O. Loew. "On the Urine of the Epileptic Spasm."
Dr. H. C. Bolton. "On Di-Nitronaphthalic Acid."
Prof. H. Wurtz. "On Natural Gases of the Palæozoic Rocks.
At the meeting held April 11th, O. Loew, "On Hydrogenium Amalgam;" Dr. Paul Schweitzer, "Notices of Recent Chemical Investigations."

New Copper Process.—The reduction of copper from such of its ores as are in the state of an oxide or semi-compound thereof, such as oxychloride or carbonate of copper, can, it is asserted, be effected by a process recently invented by Professor T. Sterry Hunt, of Canada. The method consists, first, in the use of a solution of neutral protochloride of iron, or of mixtures containing it, for the purpose of converting the oxide or suboxide of copper, or their compounds, into chlorides of copper. Second, in the use of sulphurous acid for the purpose of decomposing the oxychloride of iron formed in the preceding reaction. Third, in the use of a process for the purpose of extracting copper from its naturally or artificially oxidized compounds by the aid of the first, or the first and second of the above-mentioned reactions.—*Am. Journ. Science*, March.

Russian Minerals.—The Russian Government has recently contributed to the Cabinets of the School of Mines of Columbia College a very choice collection of Russian minerals. Among the more striking specimens are nuggets of native gold, native Platinum, Iridosmine, large Emeralds from the Urals, single and in clusters in the gangue, Topaz, Onwarovite (chrome garnet), Perofskite, Æschynite, Amazon stone, Hessite, Sarmaskite, Alexandrite, and beautiful Malachites, etc. —in all 456 specimens.

Dangerous Kerosene.—The Ohio Legislature has just enacted a very stringent law against the sale of dangerous kerosene. The standard is fixed at 110° F. for the flashing test, and the sale of an oil which flashes below this temperature is severely punished. In case a death results from oil flashing below 110° F., the seller is to be punished for manslaughter.

Lake Superior Copper Mines.—The Calumet and Hecla mines are said to have furnished nearly half the copper produced in the Lake Superior District in 1869.

The Oxy-Hydrogen Blowpipe is to be the burglar's tool of the future, with which the lock of the strongest safe can be fused out in a few minutes, the gases being conveniently transported in the compressed state in iron cylinders.

Grape Sugar.—Factories have recently been established in New York, Brooklyn, and Buffalo, for the manufacture of grape sugar from corn. The starch is extracted from the corn and changed to grape sugar by the action of sulphuric acid. The acid is neutralized with carbonate of lime, and the filtered solution is concentrated in a vacuum pan. In France bone-black is used for decolorizing. The sugar is chiefly used by brewers as a cheap substitute for a portion of the malt. It is also used for the manufacture of vinegar, the chief advantage in this case arising from the fact that the revenue tax on alcohol, the material formerly employed, is avoided.

NOTES AND QUERIES.

Polishing Braid.—Will some reader of the Chemical News inform me how the English and German manufacturers produce the fine polish on their braids?—*C. O. T.*

Electrical Heating Apparatus.—It has been several times stated that the Hôtel Dieu Hospital in Paris is successfully warmed by an electrical heating apparatus. Can any reader give a description of the apparatus employed, or refer me to a journal in which it is described? —*R. S. P.*

Bromine and Iodine.—Can any one give me any information with regard to the manufacture of bromine and iodine in the United States? —*Manufacturer.*

Bartlett's White Lead.—Is this pigment different from ordinary white lead, and is it, as some claim, a new article?—*Painter.*

Dental Vulcanite and Iodized Rubber.—Will some one tell me the difference, if there is any, between these two preparations?—*T. M. B.*

The Monnier Process for Copper and other Ores.—Where can I find it described?—*Smelter.*

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CONCERNING

ATOM-FIXING AND ATOM-DISPLACING POWERS.*

BY WALTER NOEL HARTLEY, F.C.S.

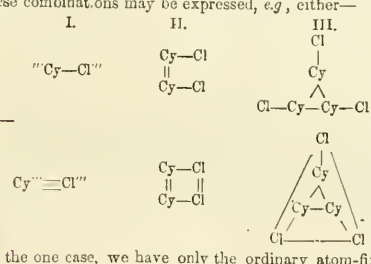
PART II.

It is very evident that the secondary atom-fixing powers of nitrogen enter into combination more frequently—that is to say, they are more powerful than the extraordinary atom-fixing powers of chlorine, bromine, and iodine; and as the secondary powers in the nitrogen are those which give trivalent functions to cyanogen, we see why the number and variety of the double cyanides is so extensive—in other words, why cyanogen is more eminently trivalent than the radicles with which it is classed.

Polymerism is the most remarkable feature of cyanogen compounds; the most notable case is that of the three chlorides of cyanogen. Although the existence of the second is somewhat doubtful, still there is a possibility of such a body being obtained.

$$CyCl, \quad Cy_2Cl_2, \quad Cy_3Cl_3.$$

There are at least two ways in which the formulæ for these combinations may be expressed, *e.g*, either—



In the one case, we have only the ordinary atom-fixing powers of the Cl exerted; but, in the second example, the chlorines are combined with each other by virtue of their triad functions.

Here follow a few cyanogen combinations, formulated in consideration of the triadic character of cyanogen.

Simple cyanides showing their power of combining with other cyanides—

Ferrocyanides—

$$Fe''.(Cy_6)^{VI}.M_4.$$

According to the general formula before mentioned, relating to the combination of multivalent radicles to form a multivalent molecule—

$$6(Cy'')=(Cy_6)^{VI}$$

$$\text{Ferricyanides....}(Fe''_2).(Cy_{12})^{IV}.M_6^{X}.$$

$$\text{Cyanic acid.....}(Cy)(HO).$$

This body admits of polymerism, for the HO here functions in place of Cl in the primary cyanogen chloride; we may accordingly look for the hydroxyl analogue of Cy_3Cl_3: this we find in cyanuric acid—

$$(Cy_3)'''(HO)_3.$$

Amides—

$$\text{Cyanamide.....}Cy'''(H_2N)'''.$$

The tertiary amide is melamine, $(Cy_3)'''(H_2N)_3$.

Tricyanamide, $(Cy_2N)'''.(CN)'''$, which may be regarded as $(H_2N)(CN)$, in which Cy_2 replaces H_2, or as NCl_3, in which Cy acts in place of Cl, is an unknown substance, and it is scarcely likely that it exists, considering the instability of the chlorides and iodides of nitrogen, to which it would correspond. The cyanide of ammonium is a body of much less stability than the iodide; tricyanamide may, therefore, be expected to be still more changeable than even chloride or iodide of nitrogen. A class of interesting and complicated ammonia compounds are the cobaltamines, such as, for instance—

$$\text{Purpuro-cobaltic chloride.....}10H_3N.CoCl_6.$$
$$\text{Luteo-cobaltic chloride .....}12H_3N.CoCl_6.$$

These have already been considered by Odling*, who offers a theory of their constitution. Taking CH_3'' as the analogue of NH_3'', the various multiples of ammonia in these complicated molecules are regarded as resembling the multiples of CH_2 in the alcohol radicles; if, then, chloride of ethyl be written—

ammonic chloride of silver may be expressed thus:—

Such is the briefest way of stating these views: an extension of them explains more complex ammoniated molecules.

There exists a very large class of substances concerning the nature of which nothing definite in the way of explanation has been offered—I mean the crystalline hydrates.

In classing hydrogen with those metals and other elements having a somewhat marked triadic character, it cannot be made an exception to the law which regulates them; therefore, if the law of Canizzaro and regular atomic displacing power are bases of any value for the classification of bodies, I am of opinion that hydrogen has the same atom-fixing power as chlorine and iodine, &c. Let us regard hydrogen as H'''; then hydroxyl, which, we find, functions as Cl'' or $(H_2N)''$, will assume the quantivalence represented by $(HO)''$. The combinations of these radicles with hydrogen then produce—

$$(HCl)''\ (H.H_2N)''\ (H.HO)''.$$

Observe the case of the bivalent carbon compound, $(CH_2)''$; this undergoes repeated condensations, to form more complex molecules which still remain bivalent. Again, $(H_2N)''$ behaves in a strictly similar manner; and this, too, we find to be precisely the case with water. Thus, by polymerism we may obtain—

$$xH_2O=(xH_2O)''^{\text{ or }'};$$

that is to say, any number of molecules of water may be combined to form a molecule with a full combining

* On page 109 (*Am. Repr., May, '70, page 249*), the line referring to the doubtful $NO''Cl_2$ and the non-existent $PO''Cl_2$ was, in my rough notes, cut out by a pencil-stroke, but, being inadvertently copied, passed into print.

* *Philosophical Magazine*, December, 1869.

[English Edition, Vol. XXI., No. 540, page 145.]

power equal to 2. It follows, naturally, that we may have sodium carbonate crystallising with 1, 2, 3, 4, 5, 6, 7, 8, 9, or 10 molecules of water. We have three parallels in the hydrocarbons, the ammoniated salts and the hydrates—

CH_2''	NH_3''	OH_2''
C_2H_4''	N_2H_6''	O_2H_4''
C_3H_6''	N_3H_9''	O_3H_6''
	&c.	
$H.CH_2$	$Ag.NH_3$	$Na_2O.H_2O$
|	|	|
$Cl.CH_2$	$Cl.NH_3$	$CO_2\ H_2O$

The various sodium carbonates may thus be generally expressed, x being equal to any whole number not exceeding 10:—

$$(Na'''_2CO_3)''\ (XH_2O)''.$$

Sodium borate.....$(NaHBrO_4)''.(H_{15}O_9)''$.
Magnesium sulphate.....$(MgSO_4)''(H_{12}O_6)''$
Crystalline chlorine hydrate..... $(Cl_2)''(H_{20}O_{10})''$.

Now there is a further resemblance between ammonia and water, than that of condensing to form complex molecules—the one may be substituted for the other; not a better illustration of this displacement of NH_3 by H_2O can be brought forward than the equations expressing the passage of melamine into cyanuric acid—

$$\underbrace{{}^{*}C_3H_6N_6}_{\text{Melamine.}}+H_2O-NH_3=\underbrace{C_3N_3H_3O}_{\text{Ammeline.}}.$$

$$\underbrace{2C_3N_3H_6O}_{\text{Ammeline.}}+H_2O-NH_3=\underbrace{C_6N_9H_9O_3}_{\text{Ammelide.}}.$$

$$\underbrace{C_6N_9H_9O_3}_{\text{Ammelide.}}+H_2O-NH_3=\underbrace{2C_3N_4H_4O_2}_{\text{Melanuric acid.}}.$$

$$\underbrace{C_3N_4H_4O_2}_{\text{Melanuric acid.}}+H_2O-NH_3=\underbrace{C_3N_3H_3O_3}_{\text{Cyanuric acid.}}.$$

Perhaps the more exact statement would be to say that hydroxyl displaced amidogen, which, however, comes to the same thing—

$$\underbrace{C_3H_6N_6}_{\text{Melamine.}}+HO-H_2N=\underbrace{C_3N_5H_5O}_{\text{Ammeline.}}.$$

Anhydrous chloride of magnesium is very difficult to obtain, on account of its very greedy absorption of water. This water cannot be driven off by heat; the action of heat expels HCl and leaves MgO. The reason of this is quite obvious, if we suppose the hydrogen of the water, and the chlorine of the magnesium chloride, to be triadic, for in that case they can combine with each other; and the hydrate of magnesium chloride is then an intelligible compound, giving an intelligible decomposition when heated.* For instance—

Magnesium chloride..... $(Mg''Cl_2''')''$.
Hydrate of $MgCl_2$..... $(Mg''Cl_2''')''(H_2O)''$.

$$\begin{array}{c} Mg=Cl_2 \\ \| \\ O=H_2 \end{array}$$

When heated, $MgO+2HCl$.

The chlorides of the dyad metals generally have a tendency to unite their chlorine to the hydrogen of H_2O; and hence the remarkable avidity with which chloride of zinc and chloride of calcium seize upon water. The chlorides of aluminium and iron have the same property, the former most markedly, and give, more or less completely, the same decomposition when heated; chloride of calcium disengages a portion of its Cl as HCl at a high temperature.

There is, of course, a possibility of other similarly-constituted bodies acting as bivalent radicles, and uniting to form a molecule without alteration of combining power; thus, chloride of sodium or potassium may play the same part as HCl in sal ammoniac and NH_3 in ammoniated compounds. We do, indeed, possess substances in which KCl and NaCl have this *rôle* allotted them; for instance, there exist the following analogous substances:—

$$\underbrace{(Co_2Cl_6'').(H_{30}N_{10})''.}_{\text{Purpuro-cobaltic chloride.}} \qquad \underbrace{(Ro_2Cl_6)''.(H_{30}N_{10})''.}_{\text{Rhodammonic chloride.}}$$

$$\underbrace{(Ro_2Cl_6)''.(Na_6Cl_6)''.}_{\text{Sodium rhodous chloride.}} \qquad \underbrace{(Ro_2Cl_6)''.\left(\begin{array}{c}K_6Cl_6\\|\\H_{12}O_6\end{array}\right)''}_{\text{Rhodous potassium hydrated chloride.}}$$

We have a further example of water, ammonia, and hydrochloric acid, all in the same molecule, united to Ro_2Cl_6, *e.g.*—

$$(Ro_2Cl_6)''.\left[\begin{array}{c}H_{18}N_6\\|\\H_6Cl_6\\|\\H_6O_3\end{array}\right]''$$

Similar iridium compounds exist, for instance—

$$(Ir_2Cl_6)''.\left(\begin{array}{c}Na_6Cl_6\\|\\H_{48}O_{24}\end{array}\right)'' \qquad (Ir_2Cl_6)''.\left(\begin{array}{c}K_6Cl_6\\|\\H_{12}O_6\end{array}\right)''$$

$$(Ir_2Cl)_6''.\left[\begin{array}{c}H_{18}N_2\\|\\H_6Cl_6\\|\\H_{12}O_6\end{array}\right]'' \qquad (Ir_2Cl_6)''.(H_{30}N_{10})''.$$

All these bodies, then, have the radicles, H_2N, H_2O, HCl, KCl, and NaCl condensed in the same manner as CH_2 in the olefines, or alcohol radicles, &c. Certain cyanogen compounds have a similar construction; for example, the ferrocyanides and ferricyanides may, perhaps, be thus represented—

$$\underbrace{(Fe''Cy_2)''.\left[\begin{array}{c}CyM\\|\\CyM\\|\\CyM\\|\\CyM\end{array}\right]''}_{\text{Ferrocyanides.}} \qquad \underbrace{\left[\begin{array}{c}Fe''Cy_2\\|\\Fe''Cy_2\end{array}\right]''.\left[\begin{array}{c}CyM\\|\\CyM\\|\\CyM\\Cy=Cy\\MCy\\|\\MCy\\|\\MCy\end{array}\right]''}_{\text{Ferricyanides.}}$$

I consider that such molecular condensations are not confined to compound bodies; the dyad elements, for instance, in potassium-pentasulphide and iodic and periodic anhydrides have a like behaviour, thus:—

$$(S—S—S—S—S)''.(K_2)''$$
$$(O—O—O—O—O).(I_2)''$$

The triads, likewise, as exemplified in the methylium periodides—

$$I_2'''=(I_2)''\left[\begin{array}{c}Me_2N\\|\\MeI\end{array}\right]''.\left[\begin{array}{c}I_2\\|\\I_2\end{array}\right]''$$

From the consideration of these complex combinations, I am led to classify the monad radicles in the following manner:—

* Kekulé. ("Lehrbuch der Organischen Chemie," vol. i., p. 359.)

With powers I. and III.—

$$\text{Metals}\left\{\begin{matrix}\text{H}\\\text{K}\\\text{Na}\\\text{Tl}\\\text{Au}\\\text{Ag}\end{matrix}\right.\qquad\text{Halogens}\left\{\begin{matrix}\text{Cl}\\\text{Br}\\\text{I}\end{matrix}\right.\qquad\text{Compound radicles}\left\{\begin{matrix}\text{H}_2\text{N}\\\text{CN}\\\text{HO}\end{matrix}\right.$$

These bodies having monad and triad characters, resemble, as a class, nitrogen and its cogeners, insomuch as they have two weaker atom-fixing powers.

It may be objected from what I have said concerning the triad nature of hydrogen, that we should expect ammonia to be a saturated molecule, and also that the ammonium-oxygen salts should undergo a similar decomposition to that of the haloid salts; for instance, taking ammonium sulphate, it might be supposed that the two free powers of the hydrogens in H_2SO_4 saturate the two free powers of the nitrogens in the ammonia molecules.

$$\left.\begin{matrix}\text{SO}_2''\\\text{H}'''\text{H}'''\end{matrix}\right\}\text{O}_2$$

$$\text{N}\left\{\begin{matrix}\text{H}\\\text{H}\\\text{H}\end{matrix}\right\}'''\qquad\text{N}\left\{\begin{matrix}\text{H}\\\text{H}\\\text{H}\end{matrix}\right\}'''$$

This is, however, not the case; as then we should have five hydrogen atoms united to each nitrogen, a combination which has not yet been effected; and, furthermore, we should be assigning to hydrogen the same intensity of atom-fixing power as Cl, Br, and I. We should thus be overlooking the fact that, in the nitrogen series, those elements with the higher atomic weights are those more powerfully pentadic. (It is true that we have no pentachloride of arsenic or bismuth; but this goes for little against the other evidence of pentad character, when we consider that no terhydride of bismuth exists, yet we have a terethide.) The power of fixing five atoms increases with the atomic weight. In the hydrogen family the same thing is obvious; Au, Tl, and I are more powerfully triadic—they, too, are the elements with the higher atomic weights; consequently we should look for a less-markedly triadic character the lower the atomic weight; much less, therefore, should we expect an element with the lowest atomic weight to have so decided a power of fixing three atoms. The reason why we have not a tertiary hydrocyanic acid is on account of the comparatively feeble atom-fixing powers of hydrogen; but we have a compound tending in that direction. Thus, by passing chlorine into HCN, Wurtz obtained this substance—

$$\left(\begin{matrix}\text{CyCl}\\\text{CyCl}\\\text{CyH}\end{matrix}\right)$$

or cyanogen trichloride with one Cl replaced by H.

That the atom-fixing powers of hydrogen are feeble, in comparison with those of chlorine and iodine, is shown by the extreme facility with which the carbonate of sodium, $Na_2Co_3.10H_2O$, under very trifling changes of temperature, and other causes, loses one or more of its molecules of water.

Again, it may be objected that, if H has a triad power, it is less likely to combine with itself than with any other element. I would, to this, answer, no; it appears to me, on the contrary, the extraordinary atom-fixing powers are the true cause of the polymerisation of N, Cy, Cl, I, and H_2O; *e.g.*—

$$(\text{Co}_2\text{Cl}_6).(\text{H}_{30}\text{N}_{10})\ \text{Cy}_3\text{Cl}_3\text{N}\left\{\begin{matrix}\text{Me}_4\\\text{I}_5\end{matrix}\right.\quad\text{Na}_2\text{CO}_3.10\text{H}_2\text{O},\ \&c.$$

In Watts's "Dictionary," it is stated that Kekulé has treated of many of the substances I have mentioned as molecular compounds, combinations resembling the crystalline hydrates. No definition of the constitution of these bodies is given; but we are told they arise from a juxtaposition of molecules. I will quote, however, a statement from one of Kekulé's publications (*Ann. der Chem. und Pharm.*, vol. civ., p. 133)—"A combination of several molecules belonging to the types, HClHCl, H_2OH_2O, $HClH_2O$, can only take place if, by the entrance of a polyamoniacradicle in the place of two or three atoms of hydrogen, a cause of union occurs." This amounts to saying that the crystalline hydrates are not combinations. Now this juxtaposition of molecules must be either a combination of molecules or not; if it be not a combination of molecules, then the resulting body is not a chemical compound, but is such a juxtaposition of molecules as we generally understand by a mixture of liquids or gases bearing no hitherto recognised relation to the atomic weights. On the other hand, if it be a combination of molecules, it is evident the molecules are not previously-saturated compounds, otherwise they would have no combining power, and consequently would not combine; for the combining power of a molecule is dependent on the non-saturated condition of one or more of its constituent atoms. Regarding a combination of SO_3 and KCl, Williamson* makes a similar statement, to the effect that neither the chlorine nor potassium are other than monad elements—they are combined to saturation; yet the two molecules, SO_3 and KCl, are held together by chemical force. Are we to have two kinds of chemical force, one holding together K and Cl, the other uniting SO_3 and KCl, or is it only a matter of degree of force exerted, which makes one class of compounds differ from another? I have endeavoured to show that the latter alternative is what I am induced to believe correct.

Somewhat in accordance with what is suggested in this paper are the results communicated to the Chemical Society by Dr. Gladstone, "On Refraction Equivalents."† Some of the elements have a double refraction value, "and this peculiarity is, in most cases, coincident with a change of atomicity. Thus iron, in the ferrous salts, has the equivalent 12·0, in the ferric salt, 20·1; and, since the refraction equivalent of iron in potassic ferricyanide is 11·7, the view suggests itself that the metal is here in the same condition as in the ferrous salts."

My formula given above for ferricyanides is in harmony with this. But amongst those elements with a double value, we find Cl, Br, I, and H; it is not improbable that behind this is lurking the evidence of the truth of my suggestions regarding monad elements. Furthermore, Dr. Gladstone mentioned that NH_4Cl gave numbers equivalent to NH_3 and HCl, which is to be expected if the true constitution be $NH_3''.HCl''$, but not otherwise. The same results may be looked for with $PCl_3.Cl_2$ and $SbCl_3.Cl_2$; for it stands to reason that these bodies do not demonstrate the usual decomposition of chlorides by heat, else we should have the following equation verified:—

$$2\text{CHCl}_3=\text{C}_2\text{Cl}_4+2\text{HCl},$$

a change which the author at one time thought possible, and vainly endeavoured, after repeated trials, to effect. What really takes place is thus represented:—

$$6\text{CHCl}_3=\text{C}_6\text{Cl}_6+6\text{HCl}+6\text{Cl}.$$

I should have preferred to have further developed these

* *Proceedings of the Royal Institution*, vol. iv., p. 277.

† Chemical News, vol. xxi., p. 114 (*Am. Repr.*, *May*, '70, *page* 263).

views, to have sought longer for proofs of their correctness, and placed them in a more carefully-stated form, but I am induced to give them publicity in their crude state, on account of my belief that a tendency of thought towards the same point is rife at the present time in the minds of others. To give an impetus, therefore, to speculation in the same direction, I commit my views to those interested in the subject.

London, March 12th, 1870.

DETERMINATION OF SULPHUR IN IRONS.

BY H. B. HAMILTON,

MILLFIELDS IRON WORKS, STAFFORDSHIRE.

THE following process will, it is believed, be found a convenient modification of that described in Fresenius's "Quantitative Analysis," since it not only dispenses with the trouble of oxidation by fusion, but effects much saving of time. A weighed quantity of iron (for puddle bars not less than 10 grms.) is thrown into a capacious flask, about an ounce of water is added, and the whole agitated to prevent caking in the after process. A cork is inserted into the mouth with two perforations, the one for a thistle funnel with tube and bulb, curved as represented in Fresenius's "Quantitative Analysis," to admit acid; the other for a tube bent at right angles. The latter tube communicates with a U-tube, containing a solution of caustic potash free from sulphate. (I attached another U-tube to the former one, containing a solution of oxide of lead in caustic potash.) Sometimes concentrated hydrochloric acid, and sometimes water, are to be poured in at the funnel, according to circumstances. As soon as the action, after pouring enough hydrochloric acid into the flask, has almost ceased, the contents of the latter are to be boiled. The flame is then taken away, and, as soon as the ebullition has ceased, air is sucked through the apparatus for about a minute. This process may be advantageously repeated, if, as will easily be discovered, the action of the acid has not entirely ceased. (After several experiments the second U-tube did not show the slightest blackening.) The contents of the first U-tube are emptied into a beaker, and the U-tube rinsed out with distilled water. A current of chlorine is allowed for some time to pass through the solution, which is then boiled, acidulated with hydrochloric acid, and boiled again, to drive off all hypochlorous acid, when it is precipitated with chloride of barium.

The contents of the flask are filtered through asbestos, and, without washing the residue at all, it is transferred again to the flask, removing every particle from the funnel by means of a small quantity of nitro-hydrochloric acid. After heating, in order to oxidise the black residue with the nitro-hydrochloric acid, water is to be added, and some carbonate of soda, free from sulphate, to neutralise the large excess of acid. After boiling, filter, taking care that the solution is still slightly acid; precipitate with chloride of barium, add the precipitated solution with precipitate to the former one, and proceed in the usual manner.

It will, perhaps, be interesting to some, if I give results of a few of my analyses according to this method:—

	Per cent of S. 1st anal.	Per cent of S. 2nd anal.	Difference.
Sample No. I.....	0·038	0·026	0·012
" No. II.....	0·088	0·073	0·015
" No. III.....	0·045	0·033	0·012

ON A NEW METHOD OF MANUFACTURING CAUSTIC SODA.

PATENTED BY M. BACHET, OF PARIS.*

BY R. CALVERT CLAPHAM, F.C.S.

EXPERIMENTS were made by Lord Dundonald as far back as 1790—1794 in making caustic soda by the decomposition of common salt with litharge. This process was conducted on a manufacturing scale by the late Mr. W. Losh, in 1799, and I am indebted to him for some details of the process then in operation.

The proportions recommended to produce the best results were 100 parts of salt and 300 parts of oxide of lead; but, when the greatest care was taken, they did not succeed in obtaining more than 3·0 parts of caustic soda; or 5·6 per cent of salt was decomposed. At that time, they had many difficulties to contend with in preventing the loss of lead in the solutions; and they had no plan in operation to re-convert the white lead pigment, which was formed back again into an oxide of lead, ready to receive a fresh charge of salt. They had, therefore, to contend with considerable expenses, and some loss of lead in melting it down again to a metallic state. It was only the high price of soda (which may be calculated as equal to £85 to £90 per ton of 70 per cent caustic soda) which enabled the operations to be conducted at a profit. I shall not trouble the Members with any details of the changes which have taken place in the manufacture of soda from that time to the present. It is sufficient to say that, after three-quarters of a century has passed away, a patent has been taken out by M. Bachet, of Paris, for the production of caustic soda by means of salt and litharge, which, in some respects, resembles the old method, but with this marked difference—that hydrate of lime is added to the mixture, which has the effect of preventing the reactions which take place between the soda and the chloride of lead by the old method, resulting in the re-conversion of the chloride of lead into common salt. And the new process also includes a method of regenerating the white lead pigment, so that it may be used over and over again. The experiments I am about to describe have been conducted by the Walker Alkali Company, at Walker, during the past nine months. Many trials were made as to the best mixtures to be used; but, as far as has yet been ascertained, the following produce good results:—

100 parts of litharge,
70 " salt,
50 " lime.

About 5 cwts. of this mixture is ground on a mill, a small quantity of water being added to dissolve the salt. It forms a white, pulpy mass, which is ready to be drawn off the mill in a quarter of an hour. Indeed, as far as experiment can prove, it appears as if the decomposition was almost instantaneous; and, if the operation is properly conducted, about 19 to 20 per cent of the salt is converted into caustic soda. It will be seen hereafter how the remainder of the salt is treated. The decompositions on the mill appear to be threefold—the production of caustic soda, of chloride of lead, and of hydrate of oxide of lead; a portion of the salt and the litharge remaining unacted upon. The pulpy material drawn from the mill is pumped into a press, which is worked at a pressure of 145 lbs. to the square inch. A clear liquid runs out, consisting of caustic soda and brine, containing a variable quantity

* Read before the Newcastle Chemical Society, March 24th, 1870.

of lead. With the object of separating completely the small quantity of lead from the soda solutions, various plans have been tried.

Sodium sulphide separates the lead easily; but there are some objections to this process.

Carbonate of soda also precipitates it as a carbonate; but, in some cases, for reasons difficult to explain, the action is not certain.

The simplest method which has been pursued is to pass the solution through hydrate of lime in the form of a filter. All the lead is precipitated; and, on testing the filtered solutions, they only give a slight colour when treated with sodium sulphide.

The lime containing the lead is afterwards used on the mill, in the place of fresh lime.

When the liquors are free of lead, they are then evaporated in an iron pan, like an ordinary salt-pan; and the salt which deposits at the bottom is gradually fished out, and may be again used, with fresh oxide of lead, on the mill.

But the process may be varied, so as to produce a much larger decomposition of the salt, by running the liquors from the press back again on to the mill, and adding thereto fresh charges of litharge and lime.

In this way, 47 to 50 per cent of the salt may be decomposed and converted into caustic soda; and a much stronger soda liquor is obtained to evaporate in the pans, a considerable amount of labour and cost of coals being saved. In either case, the solutions are concentrated till they are ready to be run into a caustic pot, where they are finished in the usual way, producing, with ordinary care, a caustic soda of 70 per cent.

We have now finished with the solutions, and must return to the dry white-lead cakes left in the press before described, the treatment of which forms one of the most important features in the patent.

When freed from its soda solutions it consists of—

Chloride of lead,
Hydrate of lead,
Litharge unacted upon,
Lime unacted upon.

As hydrate of lead has no action in decomposing salt, it becomes not only a question of how to decompose the chloride of lead, but also how to convert the hydrate into an oxide which will again act upon salt. The method which appears most likely to effect these ends is, in the first instance, to dry the material from the press, at a temperature of about 350°F. It turns to a fine orange-yellow colour, and the hydrate is decomposed and is converted into a heavy oxide.

The mass is then slowly thrown into a boiling solution of lime-water, in which the chloride of lead is decomposed, forming chloride of calcium and oxide of lead. This solution is now run off, and after one or two washings in fresh lime-water, the lead is again fit to be used at the mill. The liquors which are run off, however, are not be to thrown away, as they contain lead in solution, and it is necessary to separate it to prevent loss.

This is not a difficult operation, as in the cooling of the hot liquors the lead nearly all deposits in fine long crystals, and the remainder left in the solution is precipitated by means of common salt or hydrochloric acid, so that a mere trace remains on testing with sodium sulphide; the chloride of lead thus obtained is decomposed with lime-water as just described, and the oxide applied to the mill. From this it appears that, with ordinary care, all the lead may be recovered, but it is only fair to allow that, in conducting a large manufactory, a portion will be lost, which requires to be estimated for in the cost of production.

Thus far the process appears to work quite smoothly, but the regenerated lead obtained as above described does not in all cases act the same. Sometimes its action is quite as energetic on salt as the original litharge, but in other cases it has proved less satisfactory when worked frequently over again in the process. The cause of this change is not always sufficiently clear; in some instances, during the heating of the material, Pb 3·04 and Pb 0·2, are formed, both of which, I find, have no action on salt. Another difficulty has been in the rapid absorption of carbonic acid by both the hydrates of lime and of lead, resulting in a product which has not only no action on salt, but appears, to a large extent, to prevent the free action of the oxide of lead. When, however, the process is conducted quickly, the regenerated oxide of lead may be used over and over again more frequently; but, so far as experiment has proved, it appears likely that, after five or six operations, it will be necessary to calcine a portion of it, and this is proposed to be effected as under. It is mixed with water, and the lighter portion syphoned off, settled, and dried. This portion, which is found to contain nearly all the carbonates, is then calcined at a strong red heat, in a furnace constructed with a working bed of hard mountain limestone, but a roof of ordinary fire bricks. It parts with its carbonic acid quite easily at a red heat, and is then ready to be used in the mill again.

Such is briefly an outline of this patent, and the importance of a new process, with the object of producing caustic soda by more direct means than at present exists, cannot be exaggerated. Without taking into account the total production of soda, but confining the calculation to caustic soda alone, we find that 20,000 tons of this article are now made in England, of the value of £350,000 annually. The plant required is not expensive, consisting chiefly of mills, presses, evaporating pans, and furnaces.

On the whole, there appears a reasonable prospect, when M. Bachet's patent is fully worked out in practice, that caustic soda will be made at a considerable reduction in cost on the present plan. But as there are gentlemen present who understand these subjects in all their bearings so well, I now leave the result of the experiments in their hands, and shall be happy to hear their criticisms.

ON MICROSCOPICAL MANIPULATION.

BY W. T. SUFFOLK, F.R.M.S.

(Continued from Amer. Repr., May, 1870, page 238.)

Lesson V.

The results of aquatic collecting will require a somewhat different treatment from that recommended in the preceding lessons. Owing to the density of the medium in which the objects are viewed, and the generally diaphanous nature of the organisms themselves, comparatively little use can be made of reflected light as a means of illumination; its employment is, therefore, rather the exception than the rule.

An account of the varied modes of collecting objects of this kind and their habitats, would almost occupy a volume. For obtaining fresh-water specimens, advantage may be taken of the excursions of the various

London and provincial societies. The Quekett Microscopical Club arranges a series of excursions, which take place every fortnight during the summer months; and, as experienced naturalists always accompany these expeditions, the student may derive much practical instruction in the way of collecting and identifying specimens. The microscope should always accompany the student to the sea-side during a temporary residence, and it is well, if possible, to take the usual working instrument, well equipped with objectives and apparatus, and not some small contrivance which has nothing to recommend it but portability. The following works also contain useful information on the subject of marine and fresh-water collecting:—"Handy-Book of Algæ, &c.," Rev. W. W. Spicer; "Beale," p. 146; "The Aquarium, Devonshire Coast, Tenby, &c.," P. H. Gosse; "Seaside Studies," G. H. Lewes; "Marvels of Pond Life," H. J. Slack; "History of Infusoria," A. Prichard. See also list of microscopical works in "Beale," p. 364.

The preliminary examination of a quantity of aquatic material is generally most conveniently done in a large trough (Fig. 15, vol. xx., p. 181; *Am. Repr., Dec.*, '69, *page* 326), with a low power, O_3* and *dark-field illumination*, mirror turned aside, or *long-focus spotted-lens;* the paraboloid has too short a focus for this purpose.

A good diagnosis can often be made by examination in the bottle or tube in which the collection is brought home, with the pocket lens. Many of the larger animals and plants can be distinguished with this low power, and those too small to be distinctly made out can often be identified by a trained eye. Objects in water may be very conveniently examined out of doors with the pocket-lens, if placed between two small pieces of glass (a 3 × 1 slide cut in half, and the sharp edges smoothed with a corundum rubber, answers well): these can be kept in the waistcoat pocket, ready for use.

Portions required for more minute examination, if on plants, may be detached with the scissors or forceps. Free-swimming animals and plants, or deposits, may be taken up with a suitable pipette, by closing the upper end with the finger, and bringing the other extremity over the object to be secured. The finger is then to be removed; and the water rushes in, carrying the object with it. The finger is again applied, to close the top of the tube, which is then lifted out of the water, and the object transferred to a slide-cell or other convenient vessel.

If the object is very thin, a common slide, covered with a piece of thin glass, will serve for the examination with a tolerably high power. Should the object be liable to injury from the pressure of the cover, a cell may be used, or a hair placed between the thin glass and the slide. In all cases in which the object is required to be kept for some days, the growing slide (Fig. 16, vol. xx., p. 181; *Am. Repr., Dec.*, '69, *page* 326) should be used: some of these may conveniently be made with cells attached. The thin trough (Fig. 14, vol. xx., p. 181; *Am. Repr., Dec.*, '69, *page* 326) may sometimes be useful. All these contrivances permit the employment of the parabaloid for dark-field illumination, and also the achromatic condenser. The live-box supplied with most microscopes is sometimes useful, but has the disadvantage, from the height it raises the object above the stage, of preventing the employment of any sub-stage illuminator but the mirror.

It is frequently necessary to subject the substance under examination to pressure. For this purpose, an instrument known as a compressorium is necessary, two of which, more completely fulfilling the requirements of the microscopist than older contrivances, are the invention of the late Richard Beck (*Quarterly Microscopical Journal*, vol. xii., p. 4); we are also indebted to him for a live-trap for confining small active animals within the field of the microscope, without compressing them or otherwise restraining their movements (*Quarterly Microscopical Journal*, vol. xiii., p. 113).

The habits of marine or fresh-water animals may be watched in aquaria, which need not of necessity be expensive: basins and glass jars answer the purpose extremely well. The Marine Aquarium should always be carefully examined after the introduction of fresh specimens of seaweed, as they usually bring in with them large numbers of minute animals.

The author, instead of throwing away the results of fresh-water collection when done with, places them in a tank in the garden, used for growing aquatic plants, which, although only containing about 200 gallons of water, always yields a rich supply of microscopic objects, most of which regularly breed and appear from year to year.

Lesson VI.

Fibres used in the Manufacture of Clothing, and Analysis of Textile Fabrics.

The materials of textile manufactures may be divided into four classes, two of which are derived from the vegetable and two from the animal kingdom.

The vegetable fibres consist either of hairs or liber cells, a tissue resembling woody fibre.

Of hairs, only those covering the seeds of several species of *Gossypium* (a genus of malvaceous plants) are used in commerce, and are known as *cotton*.

The liber cells are supplied from many sources, and are used for a great variety of purposes, every kind of fabric, from fine linen to cordage, being made from them.

Familiar examples are flax (*Linum usatissimum*), jute (*Corchorus capsularis*), hemp (*Cannabis sativa*), China-grass or rhea (*Bœhmeria nivea*).

The animal materials consist of silk, an albuminous fibre produced by various caterpillars.

The remaining class comprises the hairs of those animals which are capable of being either spun or felted—such as wool and its varieties, as alpaca, &c., hairs of rabbit, beaver, &c.

Specimens Required.—Fibres of cotton, flax, hemp, silk, and wool; pieces of calico, muslin, linen, silk, flannel or blanket, and any other woven fabrics and threads procurable; also hairs of various animals.

Examine fibres of cotton, flax, hemp, silk, and wool, as described in Lessons I. and II., with O_1 or $O_{\frac{1}{2}}$, on stage-plate, by reflected light.

Notice the differences of structure. *Cotton* consists of *flattened, twisted fibres. Flax* and *hemp* are *rounded*, with more or less apparent *transverse markings. Silk* is conspicuous for the *absence of all structural peculiarities. Wool* exhibits a *circular fibre*, with *delicate markings.*

It will be seen that the four classes of fibres have all well-marked characters, and can be readily distinguished from each other under the microscope.

Mount specimens of all the fibres collected, by dry

* Ross's 4-inch objective is very suitable for this kind of work; it defines well, bears a considerable amount of eye-piece power, will take in an object of about 0·4 inch diameter, and is low in price.

process (vol. xx., p. 193; *Am. Repr., Dec., '69, page* 328), taking care, as fibrous tissues are very hygroscopic, that they are properly dried. As they will bear a heat not exceeding that of boiling water without injury, the ether process will not be required. Label, and preserve for future reference. Place, also, a small portion of the fibres of cotton, flax, and hemp in separate bottles, with saturated solution of chloride of calcium; leave them to soak for a few days, and then mount in same fluid, taking the precaution to separate the fibres by tearing them apart with needles, so that the single fibres may be well displayed before closing the cell. The silk and wool should be mounted dry, and also in balsam, with as little heat as possible, if transparent specimens are required.

As the mountings in chloride of calcium will be some days in hand, unless the air-pump is used, prepare portions of cotton and flax, on slides, with turpentine, which will render the fibres transparent; and examine with a power of not less than O¼ (O¼ will be better), with polarised light, using achromatic condenser and eye-piece analyser (vol. xxi., p. 8; *Am. Repr., March, '70, page* 135). If the condenser is not accessible, the intensity of the illumination may be greatly increased by concentrating the light of the lamp on the concave mirror with the condensing-lens.

The *cotton* will display *more or less colour*, indicating doubly-refractive properties, but *no very marked structural peculiarities.* The *flax* will show *a vast amount of structure.* The transverse markings seen by reflected light will become more conspicuous, and other markings of a more or less spiral nature will, with proper adjustment of the selenites (vol. xxi., p. 9; *Am. Repr., Mar., '70, page* 136), be rendered visible. These consist of thickenings of the cell wall, known as secondary deposits, and are easily seen by polarised light, owing to their doubly-refractive power differing from that of the thinner portions of the tissue; while, by ordinary transmitted light, they would have been nearly invisible, owing to their transparency. It is much easier to distinguish the fibres of cotton and flax in a mixed fabric by observations with polarised light than by any other means. A power of O1 is quite sufficient when merely the presence of cotton on flax has to be determined.

A careful series of observations on liber cells is much wanted. At present, it is difficult to distinguish between flax and hemp, and other fibres of the same class, so that they might be detected with certainty in mixed fabrics. The chief impediment consists in the very close resemblance of all these fibres to each other. It is, in general, much easier to distinguish them in mass, by various peculiarities of colour, texture, &c., than by the most careful microscopical examination of single fibres.

The action of dyes might reveal some peculiarities connected with these tissues. Experiments on cotton have been tried by Mr. W. Crum, of Manchester. Transverse sections* have been examined by a Continental observer, and, although somewhat difficult to obtain, might be studied with advantage. The whole subject is much in need of investigation.

Woody fibres are used occasionally for purposes of adulteration; an instance is mentioned under silk. A curious case came under the author's notice, in which cotton wick, intended for the manufacture of composite candles, was adulterated with a small quantity (about 5 per cent.) of some undetermined liber fibre. Trivial as was the amount of this admixture, it entirely unfitted the wick for the purpose for which it was intended, causing it to remain unconsumed, and accumulate, instead of bending over to the outer part of the flame, and burning away.

For account of liber cells, see—Bentley's "Manual of Botany," p. 30; article, *Liber*, "Micrographic Dictionary," p. 417; *Science Gossip*, vol. ii., p. 10.

The length of cotton-fibre (*staple*) is determined by drawing out a tuft of the cotton repeatedly between the fingers, until the hairs are laid parallel, and then measuring the length of the tuft. This is the mode of measurement in use among cotton-brokers. An easy and accurate method of measuring single fibres of cotton had long been a desideratum in analytical operations. In 1862, Captain C. J. Mitchell, of the Government Central Museum, Madras, writes, respecting a process he had used for this purpose:—"It is exceedingly tedious, and very trying to both eyes and head." Shortly afterwards, the author endeavoured to measure single fibres by fixing them with gum upon a glass slide, making a drawing with the camera-lucida, and measuring the curved line so obtained with a map-measurer. The enlarged drawing was from 18 inches to 2 feet in length. The chief objection to this process was the amount of time occupied in the investigation, ordinary micrometrical operations not being applicable, on account of the great length of the fibres and the impossibility of measuring them as straight lines; hence the necessity of making drawings, and following all the curves with the little measuring wheel. A simple and accurate process has been invented by Mr. C. O'Neill, and is described by him in a communication to the Literary and Philosophical Society of Manchester ("Memoirs," 1863—4, p. 389). The apparatus employed consists of a plate of glass, on which is ruled a scale 2 inches long, divided into tenths, a pair of fine forceps, and two camel-hair pencils. The scale is laid upon a piece of black cloth, and well lighted, by daylight or a lamp, with condensing lens. The fibres are selected, and held by the forceps, and, with one of the pencils, moistened in the mouth, pressed and drawn out on the glass plate; the forceps are then dropped, and the other pencil brought into use to lay out the fibre, the length of which is then read off. The operation requires considerable practice, but, when acquired, single fibres can be measured to 0·05 inch with sufficient rapidity for analytical purposes. As some cotton-fibres—such as Sea Island—reach the length of 2 inches, it is well to have the scale extended to 3 inches: this will also prevent the necessity of being careful about placing the fibre on the beginning of the scale, as there will be plenty of space. And it is convenient to have a scale of about the same length divided into millimetres. For comparison with Continental observations, Mr. O'Neill gives the following results of some observations on the length of cotton fibres:—

	Maximum. in.	Mean. in.	Minimum. in.
Sea Island	2·00	1·6800	1·35
Another sample	2·05	1·4440	1·10
Queensland	1·95	1·5010	1·10
Egyptian	1·55	1·2520	0·95
Pernambuco	1·50	1·6750	0·75
Surat	1·15	0·9425	0·75
Another sample	1·10	0·9250	0·55
Another sample	1·05	0·9050	0·70

* Fibres, hairs, and other long thin substances of which sections are required should be made up into bundles with weak glue, and cut into thin slices with a sharp razor; the sections can be liberated by dissolving the gelatine in hot water.

In another communication (1862-3, p. 389), Mr. O'Neill describes an ingenious instrument for measuring the tensile-strength of fibres. The following are some of the mean breaking-weights of single cotton-fibres:—

	grs.
Sea Island	83·9
Another sample	90·0
Surat	105·8
Another sample	141·9
Egyptian	108·0
Another sample	127·0
Pernambuco	140·0

These determinations are of great value to the manufacturer. And those intending to make textile fabrics their study would do well to consult Mr. O'Neill's papers.

The amount of twisting in a thread is a very important element in the estimation of its strength. The famed Dacca muslins owe much of their superiority in lightness * and strength to the tightness of the twist in the delicate filaments of which they are composed. This has been determined by Dr. J. F. Watson, who gives the following as the average number of twists per inch in four samples of muslin:—French, 68·8; English, 56·6; Dacca, 110·1; Dacca (another sample), 80·7. The whole subject is carefully worked out by Dr. Watson in "The Textile Manufactures and Costumes of the People of India," pp. 59—74.

Cotton is mixed with other fibres legitimately in the well-known "union cloth," a compound of flax and cotton, and as an adulteration, with woollen fabrics, and in some specimens of lint.

Silk will be found to burn differently from the fibres of the two classes hitherto considered. It curls up, and ultimately fuses and burns, giving off the disagreeable odour common to animal tissues, as hair, wool, feathers, &c. The fibres depolarise light, giving more or less colour, but do not exhibit any structural peculiarities. Silk is entirely dissolved when boiled in strong solutions of caustic potash or soda. If *cautiously* heated on a slide in a strong solution of soda, the fibres will be found to swell, and bulge out in parts.

Admixtures of other fibres with silk are easily detected, by the appearance of the unravelled threads, under the microscope. The material most commonly used to adulterate silk is jute. The microscopical characters of this fibre are not of a very marked description. It is best distinguished by examining the residue under the microscope after the sample has been boiled in a strong caustic alkaline solution. Specimens of silk, breaking and fraying when pressed into tight folds, may always be suspected of containing jute: the beautiful gloss of this fibre, when carefully prepared, is the reason of its selection as an adulterating material.

Wool.—As already observed, this fibre presents very marked structural peculiarities. In burning, the same phenomena are apparent as in the case of silk; it is also soluble in hot alkaline solutions. The histological nature of the surface-markings may be considered undetermined at present, the apparent imbrications being interpreted by some as scales: and in many hairs (those of some of the bats especially) this character is very marked (M. C. Cooke, *Transactions of the Quekett Microscopical Club*, vol. i., pp. 33 and 55, Plates 1, 2, and 3: article, *Hairs of Animals*, "Micrographic Dictionary," p. 330; "Carpenter," p. 704).

Two valuable communications on "Wool, Commercially and Microscopically Considered" were made by Mr. N. Burgess to the Quekett Microscopical Club. Unfortunately, only abstracts appear in the *Transactions* (vol. i., p. 23). In this paper some important points of microscopical structure, bearing upon the felting process, are noticed. It is shown that the felting qualities of wool depend upon the number of waves or curvatures in the length of a fibre, and not upon the apparent serrations or imbrications.

When heated on a slide with strong solution of soda, wool swells, the medulla or interior cellular portion becomes more distinct, and the imbrications disappear, seeming to have unfolded.

Wool is mixed with other substances in the manufacture of fabrics generally with the view of improving the texture or appearance, and not usually as an adulteration.

ON THE

LIGNITES OF MIDDLE AND SOUTHERN ITALY.*

BY AUGUSTUS A. HAYES, M.D.,

STATE ASSAYER OF MASSACHUSETTS.

Since the independence of the Free States of Italy was achieved, scientific explorations have shown the existence of various and considerable natural resources, which may become of great national importance to that country. Among these are numerous deposits of lignite and bitumens; and even sources of mineral oils have been found.

Professor Carlo Cassola, of Naples, one of the most active scientific men of that country, has influenced the present Government so far that aid in the collection of specimens from various localities has been secured; and the parcels sent to Naples now form a large aggregate in the extensive laboratory and museum in charge of Professor Cassola.

Through the kindness of the Professor, I was allowed to examine and analyse some of these samples; and I also visited one of the deposits, a few miles distant from Benevento, in company with himself, scientific friends, and representatives of the Government.

The lignites are found in a formation which represents the tertiary of this country. Clay, conglomerate, and decomposing schists were the immediate enclosing rocks of this locality, and the beds had evidently been broken up and moved from position of deposition by superficial changes.

Some of the lignites presented the varieties of brown coal, with more or less of woody structure visible, and they differed in power of retaining moisture, in gravity, colour, and compactness. One variety was remarkable, inasmuch as it so closely resembled Cannel coal in appearance and general physical characters as to be easily taken for Cannel. It requires, indeed, careful examination to enable one to distinguish it from Cannel; and, as seen, it promised to prove an excellent fuel.

I engaged in the chemical analysis of the Cannel-like variety with great interest, and soon found it to differ remarkably from ordinary lignite, in containing a large proportion of combined water, which was retained after long exposure to a high temperature; indeed, some

* A piece of fine Dacca muslin, 1 yard wide and 10 yards 12 inches long, weighed only 1565 grains (Dr. Watson; work cited, p. 75).

* From the *American Gas-Light Journal*. Communicated by the Author to the Chemical News.

samples afforded water at 600° F., and the point of complete desiccation did not vary more than 50° F. from the point of temperature necessary to cause decomposition.

An air-dried, selected, average sample of the Cannel-like variety afforded—

Moisture, as given off at 100° to 110° C.	3·40
Water, lost in air at 200° to 230° C.	18·20
Volatile combustible matter	29·80
Solid carbon, as compact coke	43·60
Greyish-white ash	5·00
	100·00

The above composition does not express a valuable fuel; and other samples contain, not only more combined water, but earthy substances also, which would appear as ash in large amount. Indeed the varieties of these minerals found in Southern Italy, when compared with good laminated coal, as fuel or as a source of power, did not warrant the belief that they can replace coal.

This is a subject of vital importance to a nation wishing to maintain steamships upon the ocean, or to carry on those operations in which fuel is an essential element of aid; and every well-wisher of Italy will be interested in the effort now put forth in the search of coal, and in devising substitutes for this mineral suitable for consumption on ship-board. There is much of newly-awakened enterprise and activity of mental ability in free Italy, and the sources of physical well-being and progress were never more carefully scanned in all directions.

In connection with the subject of fuel, it was a happy suggestion of Professor Cassola that led to the mode in which these lignites and hydrous fuels may be burned with advantage. He proposed to mix or saturate the porous lignites with the crude natural bitumens, and burn the nearly-dry artificial mixture thus made as coal, in any ordinary stove or fire-place, on ship-board or in work-shops.

The lignites readily absorbed about 20 per cent. of the semi-fluid hydrocarbon; and the result was not adhesive, and could be quite as comfortably handled as softer varieties of coal. This mixture, by estimation, had a high practical value, and presented the utilisation of crude petroleum as fuel under a new and inviting aspect.

The burning of any kind of fluid hydrocarbon which can be converted into oils as fuel must be regarded always as a misapplication of a valuable natural production. With this conviction, I had witnessed the experiments made on board a gun-boat of our own Navy, where much invention of a high character had solved the problems and overcome the obstacles presented in burning completely. Yet, unless in other applications the crude material has little value, it can never compete with coal economically.

The bitumens of Southern Italy resemble those of California generally, though their petroleum oil has been drawn from tolerably-deep wells; and the latter are, therefore, adapted to this new use, becoming valuable, not as fuel *per se*, but in conferring on a poor hydrous-combustible a greatly-increased power in producing heat.

This suggestion of the Professor at once led to application on a useful scale. The Government placed a steamship in order for comparative trials of the new fuel (that is, average lignite which had absorbed about one-fifth of its weight of dark, semi-fluid bitumen, and become nearly dry), and, on the other hand, the best English steam-coal supplied to the Navy, were used in equal weights in producing steam-power. Engagements prevented me from witnessing the trials; but the Admiral's report, expressing the practical results of propelling the ship from point to point of equal distances, gave for the new fuel a value at least equal to that of the best coal, for naval purposes. The mixed fuel, in the trials, was burned in the ordinary coal-furnaces, and did not produce smoke.

This application of Professor Cassola becomes of great importance, therefore, if subsequent search shall show that Italy possesses large deposits of lignite and bitumens; and this mode of utilising hydrous lignites carries with it those practical features which recommend its adoption wherever hydrous fuels and bitumens can meet as products of small value on the spot.

In California, where semi-fluid bitumens exist, the increasing facilities for transportation may allow the value of lignites of that and other states to be greatly increased by the absorption of bitumen, so as to form an artificial fuel in which the combined water of the lignite will be utilised to form a strongly-heating flame in the otherwise smoke-producing vapours of the bitumen.

Boston, Mass., December 29th, 1869.

ON THE

RELATION BETWEEN THE SUN'S ALTITUDE AND THE CHEMICAL INTENSITY OF TOTAL DAYLIGHT IN A CLOUDLESS SKY.*

BY HENRY E. ROSCOE, F.R.S., &c., AND T. E. THORPE, PH.D., &c.

In this communication, the authors give the results of a series of determinations of the chemical intensity of total daylight, made in the autumn of 1867, on the flat plateau of the River Tagus, about 8½ miles S. E. of Lisbon, under a cloudless sky, with the object of ascertaining the relation existing between the solar altitude and the chemical intensity of the light.

The experiments were made as follows:—1. The chemical action of total daylight was observed in the ordinary manner; 2. The chemical action of the diffused daylight was then observed, by throwing on to the exposed paper the shadow of a small, blackened brass ball, placed at such a distance that its apparent diameter, seen from the position of the paper, was slightly larger than that of the sun's disk; 3. Observation No. 1 repeated; 4. Observation No. 2 repeated. Next, the means of observations 1 to 4 were taken. The sun's altitude was determined by a sextant and artificial horizon. One of the sets of 134 observations was made as nearly as possible every hour.

It has been already pointed out, and proved by experiments made at Kew, that the mean chemical intensity of total daylight, for the hours equidistant from noon, is constant. The results of the present series of experiments prove that this conclusion holds good generally. One of the chief results arrived at is that, although the chemical intensity for the same altitude, at different places and at different times of the year, varies according to the varying transparency of the atmosphere, yet the relation, at the same place, between altitude and intensity is always represented by a straight line.

* Abstract of a paper communicated to the Royal Society.

ON THE ACIDS CONTAINED IN CRAB OIL.*

BY WILLIAM J. WONFOR,

STUDENT IN THE LABORATORY OF THE GOVERNMENT SCHOOL OF SCIENCE, DUBLIN.

Crab oil is obtained from the nuts of a tree known botanically as *Hylocarpus carapa*, and also as *Carapa Guianensis*. This tree grows abundantly in the forests of British (also of Netherlands) Gniana. The oil is prepared from the kernels, by boiling them for some time in water, and then placing them in heaps, and leaving them for some days. They are next skinned, and afterwards triturated in wooden mortars, until reduced to a paste, which is spread out on inclined boards, and exposed to the sun: the oil is thus melted out, and trickles into receiving vessels.

The author obtained the oil as met with in the country it is prepared in, by native Indians, and hence by rather primitive and unskilful methods. It is a semi-fluid, butyraceous mass, evolving a penetrating odour. The oil melts at 55°. In order to obtain the acids, the oil was saponified with a solution of potassic hydrate, and the soap obtained dissolved in a large quantity of water, to which solution of sodic chloride was added in excess. The soap thus separated was washed, and again dissolved in water, and that solution decomposed by means of hydrochloric acid. The liberated fatty acids were collected and pressed, and, after having been carefully freed from any sodic chloride, again saponified, and the same treatment repeated; and the soda-soap obtained decomposed with tartaric acid. The melting-point of the mixed acids was 40°.

The author describes, further, at great length, the purification of the acid, and states that its melting-point is 57.°

The acid presents the appearance of a white, glistening mass, which, on being submitted to organic elementary analysis, gave, in 100 parts:—Carbon, 75·00; hydrogen, 12·50; oxygen, 12·50. Formula, $C_{16}H_{32}O_2$. The composition of the argentic palmitate is, $C_{16}H_{31}O_2Ag$.

The author also prepared the ethylic palmitate, $C_{16}H_{31}(C_2H_5)O_2$, and also describes a baric salt. He further states that, for various reasons, he was, to his regret, not enabled to examine quite satisfactorily the acid of the lower melting-point contained in the original saponified and purified mass.

ON THE

CHEMICAL EQUILIBRIUM BETWEEN CARBON, HYDROGEN, AND OXYGEN.

BY M. BERTHELOT.

The following facts are the result of experiments on decomposition of carbonic acid, steam, and the prolonged reaction of the spark on sundry mixtures of hydrogen, oxide of carbon, oxygen, steam, and carbonic acid.

1. *Decomposition of Carbonic Acid.*—This gas, when traversed by a series of induction-sparks, decomposes rapidly. The decomposition reaches a certain limit, then retrogrades, again augments, diminishes, and so on, without tending towards any fixed limit. This is shown by the following table, which demonstrates the volume of gases non-absorbable by potash (oxide of carbon, and oxygen) contained in 100 volumes of the mixture under analysis. The experiment was conducted with 200 c.c. of gas, the sparks, which were strong and slow, proceeding from a Ruhmkorff coil fed by six elements of Bunsen. The specimens were taken and analysed from time to time.

After 5 minutes	.....	13·0	After 99 minutes	.....	7·0
12 "	.....	10·0	110 "	.....	6·0
14 "	.....	9·5	128 "	.....	6·0
24 "	.....	7·5	143 "	.....	5·0
39 "	.....	5·5	153 "	.....	7·0
54 "	.....	10·0	163 "	.....	10·0
84 "	.....	12·5			

The relation 2–1 between the oxide of carbon and the oxygen was verified every time; it exists only when the spark plays between platinum wires placed at a great distance from the mercury, otherwise part of the oxygen is absorbed by the latter. All this tends to establish the important fact that the decomposition of carbonic acid does not tend towards any fixed limit; this is contrary to what occurs during the decomposition of acetylene and many other reactions. This absence of a fixed limit indicates the simultaneous existence of two contrary but independent causes. Of this more anon.

2. The extreme limits between which the decomposition oscillates have no elements of constancy; all depends on the length and intensity of the sparks, as a comparison of the preceding table with the following will show.

		Short sparks.		Very short and feeble sparks.*
After 10 minutes	.....	14·0	.....	—
" 15 "	.....	—	.....	6·0
" 25 "	.....	18·0	.....	—
" 37 "	.....	19·0	.....	13·5
" 60 "	.....	1·5	.....	29·0
" 82 "	.....	24·0	.....	2.0

These figures show progressive decomposition followed by re-combination.

3. A mixture of 2 volumes of oxide of carbon and 1 volume of oxygen, with a suitable quantity of carbonic acid, does not explode. It is only necessary that the carbonic acid should constitute 60 or 65 hundredths of the entire volume. The limit is still somewhat uncertain, according to the intensity of the sparks. The re-united oxide of carbon and oxygen form, in this instance, from 35 to 40 hundredths of the entire mass.

My next researches related to the limits of the composition of the explosive mixtures formed of oxide of carbon and oxygen.

4. I first of all verified the observations of Dalton, according to whom explosion does not occur in the mixture of the two gases containing less than the fifth, or more than the 14-15ths of its volume of oxide of carbon. These limits vary slightly with the intensity of the spark; moreover, in the same mixture, the combustion is sometimes complete and sometimes incomplete. For instance, a mixture formed of—

Oxide of carbon.....	18·6
Oxygen.....	81·4

burnt with flame, all the oxide of carbon being changed into carbonic acid in one experiment; while, in another, only 10·0 of it was formed. The result was similar in limited mixtures in which oxide of carbon predominated, or even oxide of carbon and oxygen in the presence of excess of carbonic acid. These variations are due to the cooling action of the excess of gas.

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* Abstract of a paper read before the Royal Society. Communicated by Dr. Maxwell Simpson.

* Two elements of Bunsen.

5. Can combination be produced below the limit of explosive combustion, and to what extent? It is only known that, at a certain distance within that limit, the combination is explosive and complete, whilst, at a certain distance beyond it, no combination is appreciable under the influence of a single spark.

Now I have perceived that, in all mixtures of oxide of carbon and oxygen beyond the point of explosion, the combination takes place under the influence of a current of prolonged sparks, and that it is completely effected, whatever may be the excess of oxygen or oxide of carbon; for instance, in a mixture formed of—

Oxide of carbon	13·0
Oxygen	87·0

a current of strong sparks, prolonged during a minute, was sufficient to form 6·5 of carbonic acid; in five minutes, this figure was increased to 13·0. The result was the same with sundry mixtures containing 8·0 and 5·0 of oxide of carbon; the same with mixtures in which oxide of carbon predominated, the oxygen being 3·3 and 1·0, only in the case of these latter more time was required to complete the action. These different results furnished the types of a progressive action, which tends to a complete combination under homogeneous systems.

6. In order to establish the fact more fully, I also worked upon the reciprocal systems, which resulted in complete reaction, whatever were the mixtures of carbonic acid and oxygen, or carbonic acid and oxide of carbon, whose composition approximates to that of systems corresponding to the limit of explosive combustion. Such are the following—

Carbonic acid	16·6	Carbonic acid	13·0
Oxygen	83·4	Oxide of carbon	87·0

After being subjected to the sparks for one hour, I discovered exactly the same volume of carbonic acid; therefore the presence of a suitable excess of oxygen or oxide of carbon completely hinders decomposition.

7. It is altogether different in cases where oxygen or oxide of carbon are contained in the mixture in only slight proportions; for instance, a mixture consisting of 96·5 of carbonic acid and 3·5 of oxide of carbon, when subjected to a current of sparks for a quarter of an hour, augmented to 5·1, by reason of the formation of 3·4 of oxide of carbon and 1·7 of oxygen.

Mixtures in which carbonic oxide is mingled at once with oxide of carbon and oxygen, in the proportion of 2 volumes of one to 1 of the other, behave in a particular way; they are reciprocal with those which ensue from the decomposition of carbonic acid, and furnish the same results for an equivalent compound. Thus, the carbonic acid forming less than 60-100ths, the combination is complete and explosive, as has been already stated. Below 60-100ths, the combination is partial, always incomplete, and does not tend towards any fixed limit.—*Comptes Rendus*, vol. lxviii., p. 1035.

ON THE

DETERMINATION OF PHOSPHORIC ACID.*

BY WILLIAM CARLETON WILLIAMS,

STUDENT IN THE LABORATORY OF OWENS COLLEGE.

Of the many methods proposed for the separation of phosphoric acid from the alkaline earths, few are better than the one devised by W. Reissig, founded upon a process originally described by Reynoso. This method, although used in many German laboratories, has, strange to say, found but little favour among English chemists. This is probably owing to the somewhat complicated and tedious nature of the operations required. The modifications described in the following communication considerably simplify the process, and may, possibly, lead to its more general adoption.

Reissig's method depends upon the fact that, when metallic tin is added in excess to a solution of the phosphate of the alkaline earths in nitric acid, the stannic acid formed by the oxidation of the metal combines with the phosphoric acid and completely removes it from solution. On filtering, therefore, we at once separate the alkaline earths which remain in solution from the insoluble combination of stannic and phosphoric acids. In order to determine the amount of phosphoric acid contained in the tin oxide, the compound is dissolved in a small quantity of concentrated potash solution, when the two acids dissolve as meta-stannate and phosphate of potassium; the fluid is now saturated with hydrogen sulphide, a small quantity of ammonium pentasulphide added, and, lastly, a slight excess of acetic acid. The tin sulphide is then separated by filtration; all the phosphoric acid is contained in the filtrate, and its amount may be determined by the ordinary method as magnesium ammonium phosphate.

The chief disadvantage of this method arises from the necessity of employing a large excess of metallic tin, in order to completely remove the phosphoric acid from solution. The bulk of tin sulphide obtained is, therefore, very large, and its filtration and washing is an exceedingly long and tedious operation. In order to shorten the process, Reissig recommends that the alkaline solution of the phosphate and stannate be transferred to a weighed flask of 1000 cubic capacity, and then diluted with water until the fluid measures about 900 cubic; the solution is next saturated with hydrogen sulphide, then ammonium sulphide and acetic acid in slight excess added, and the tincture diluted until the whole weighs 1000 grms. After standing for a few hours the clear supernatant liquid is carefully poured through a filter, taking care not to disturb the precipitate. In the filtrate the phosphoric acid is estimated as magnesium pyrophosphate. The amount of the fluid employed in the determination is ascertained by again weighing the flask. On subtracting the weight of the tin-sulphide calculated from the quantity of the metal originally employed, we have all the data required to determine the amount of phosphoric acid in the entire solution.

This method of proceeding is not altogether faultless in principle. (1) It pre-supposes that from a known weight of tin-foil we are able to calculate the amount of tin-sulphide it will yield. Now the tin-foil of commerce is seldom or never pure, it almost invariably contains a considerable proportion of lead, often amounting to one-third of its weight,* and this of course passes into the nitric acid solution of the alkaline earths. (2) Since only a portion of the phosphoric acid present is actually weighed, the remainder being deduced by calculation, the chances of ultimate error are considerably increased.

These sources of error are removed by simply filtering and washing the tin-sulphide by means of the Bunsen "water-pump," an operation of comparative short duration. We thus obtain the whole quantity of phos-

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* Read before the Manchester Literary and Philosophical Society, March 22, 1870. Communicated by Prof. Roscoe, Ph.D., F.R.S.

* The tin-foil employed in my experiments contained 31·35 per cent lead.

phoric acid in solution, and entirely obviate the numerous weighings, involving, too, the very uncertain correction for the amount of tin-sulphide present.

In order to test the trustworthiness of the method thus modified, the following experiments were undertaken. A quantity of pure calcium phosphate was prepared by adding calcium chloride to an excess of sodium phosphate, and the precipitate washed, dried, and ignited. About 0·5 grm. of this compound was weighed out into a porcelain basin, and dissolved in a small quantity of nitric acid; the solution was then concentrated, and the strongest nitric acid (boiling at 86° C.) added until the calcium nitrate commenced to separate out. This was immediately redissolved by the addition of a few drops of dilute nitric acid. The nitric acid solution is now in the highest possible state of concentration: on throwing a small quantity of tin into this solution, the metal is rapidly oxidised to stannic acid, and the supernatant liquid remains perfectly clear. The preliminary heating of the solution is indispensable, since in the cold the metal is apt to become passive, when it completely resists the action of the acid. The precipitate is now dissolved in a small quantity of caustic potash, and saturated with hydrogen sulphide; on adding acetic acid in slight excess the tin-sulphide is precipitated. The precipitate is then separated by means of the Bunsen "filter-pump," and the whole of the phosphoric acid is contained in the filtrate. After concentrating the solution, and again filtering from a minute precipitate of tin-sulphide, which invariably separates out (tin-sulphide being slightly soluble in solutions containing hydrogen sulphide), the phosphoric acid may be precipitated as the magnesium ammonium salt, and weighed as pyrophosphate.

I. Ratio of tin to phosphoric acid, 4 to 1.

$Mg_2P_2O_7$. P_2O_5.

I. 0·5135 grm. cal. phos. gave 0·405=50·45 per cent
II. 0·447 " " " 0·358=50·78 "

Mean..... 50·61 "

The lime was determined as caustic lime after removal of the lead by means of hydrogen sulphide. The mean of two concordant analyses gave 49·65 per cent of lime.

Hence the composition of the calcium phosphate is—

Phosphoric acid	50·61
Lime.....	49·65
	100·26

It is, therefore, evident that the amount of pure tin required need not exceed four times the weight of phosphoric acid present.

The following experiments show that this is, moreover, the minimum quantity that can be used.

II. Ratio of tin to phosphoric acid=3·0 to 1.

$Mg_2P_2O_7$ P_2O_5

0·477 grm. cal. phos. gave 0·307=41·53 per cent
III. Ratio of tin to phosphoric acid=3·5 to 1.

$Mg_2P_2O_7$ P_2O_5

0·598 grm. cal. phos. gave 0·388=41·50 per cent
0·434 " " " 0·304=44·82 "

In order to confirm the above results I have determined the proportion of lime and phosphoric acid contained in the calcium phosphate employed in the analyses, by dissolving the compound in hydrochloric acid, and adding sufficient sulphuric acid to precipitate the base. To each volume of the liquid two volumes of alcohol were added, and the mixture allowed to stand about twelve hours, when it was filtered and the precipitate thoroughly washed with alcohol. The filtrate containing the phosphoric acid is evaporated to dryness, the residue dissolved in water, and the acid precipitated as the magnesium ammonium salt. The lime was weighed as sulphate.

I. 0·525 grm. gave 0·411 MgP_2O_7=50·08 per cent P_2O_5
II. 0·507 " " 0·396 " =49·96 per cent P_2O_5

The lime amounted to 50 per cent. Hence the composition of the calcium phosphate is—

P_2O_5.....	50·02
CaO.....	50·00
	100·02

exactly agreeing with the determinations made by the tin method.

ON THE ETHYLIC SERIES OF SILICIUM.

BY MM. C. FRIEDEL AND A. LADENBURG.

The observations, of which an account is here given, tend to prove the truth of the opinion expressed by M. Dumas, some thirty years ago, that hydrogen was not the only element susceptible of substitution, and that some body might be found capable of replacing carbon.

Sundry articles upon the subject, written first by MM. Friedel and Crafts, and afterwards by ourselves, show, in the first place, that silicium is a tetratomic element like carbon, and deserves comparison with it on that account; but the analogy does not end here. Silicium is capable of acting after the manner of carbon, and serving as a link for several hydrocarbonized groups by furnishing bodies presenting great analogy with certain hydrocarbides, and governed by the same law of saturation, provided the silicium be reckoned as an equivalent of the carbon, atom for atom. From these siliceous hydrocarbides several bodies may be derived, whose residues, containing silicium, united with carbon and hydrogen, and play the part of radicals exactly like simply hydrocarbonized groups. After studying a large number of compounds, forming what may be called the methylic group of silicium, it was necessary to find bodies corresponding to more elevated groups of the carbon series, and thus to show that silicium in groups analogous to organic compounds, may not only be saturated by atoms of carbon, but partakes with that element the property of saturating itself at least partially. This was at last effected after numerous fruitless attempts.

Upon endeavouring to remove from chloride of silicium a portion of the chlorine contained in it, so as to change it into a chloride more complex by one molecule, the silicium will be completely reduced if a metal be employed, such as sodium, zinc, or silver. In the case of hydrogen, which was used by Ebelmen for preparing sesquichloride of titanium, only a small quantity of silicichloroform was obtained.

It was believed that the iodine of silicium, SiI_4, discovered by one of us, would be attacked at a low temperature and would thus become better adapted to the end in view; experiments have justified the supposition. The iodide was heated for some hours at a temperature approaching its boiling point (290°—300°) with perfectly dry and powdery silver. The tetraiodide was then transformed into a white mass presenting a totally different aspect from its primitive appearance. Upon treating the contents of the vessel with a small quantity of sulphide of carbon, to extract any remains of tetra-

[English Edition, Vol. XXI., No. 542, page 171; No. 543, page 181.]

iodide, and after several washings, dissolving it in a large quantity of hot sulphide of carbon, the product consisted of beautiful colourless crystals, in hexagonal prisms or rhomboidal bases, acting upon polarised light after the manner of doubly refracting substances, and which fume in the air and decompose, forming a white substance. When treated with potash, a lively evolution of hydrogen ensues.

Analysis proves that these crystals are the iodide desired, Si_2I_6, formed by deducting one atom of iodine from the tetraiodide, and re-combining the two residues (SiI_2). The quantity of hydrogen evolved by the action of the potash confirms the result of the analysis, being 2H in Si_2I_6, which should be, according to the equation—

$$Si_2I_6 + 4H_2O = 2SiO_2 + 6HI + 2H.$$

The hexa-iodide of silicium cannot be distilled either under atmospheric pressure or in a vacuum. It sublimes partially, but decomposes to a great extent into tetra-iodide, leaving an orange-red residue, whose composition corresponds to the formula SiI_2, and which is insoluble in sulphide of carbon, benzol, chloroform, and chloride of silicium. This last iodide is changed by water into a white or greyish mass, evolving much hydrogen in the presence of potash. The hexaiodide melts in a vacuum, but with partial decomposition at a temperature of 250°. It is much less soluble than the tetra-iodide in sulphide of carbon at 27 ; one part of this liquid dissolves 2·2 parts of SiI_4 and only 0·26 of Si_2I_6. When crystals of the hexaiodide are thrown into iced water, they decompose without evolution of hydrogen, and the white substance, which remains when dried in a vacuum at 100°, presents a composition corresponding to the formula $Si_2O_4H_2$, which is proved by the quantity of hydrogen disengaged by the potash or collected as water, by combustion with oxygen, and by calcining the mass which decomposes with incandescence, and an evolution of hydrogen, leaving a residue of silica, whose weight is almost identical with that of the primitive substance. The iodide of silicium is transformed into a hydrate, $Si_2(OH)_6$, upon contact with water; this hydrate loses $2H_2O$ to form the body, $Si_2O_4H_2$, whose composition is analogous to oxalic acid, and which may be called silici-oxalic hydrate.

Salts of this compound could not be obtained. They became decomposed by even the weakest bases, with evolution of hydrogen, as is done by potash under other circumstances in the case of oxalic acid.

Several reactions were tried with the hexaiodide with a view to obtaining a volatile compound without decomposition. After ascertaining that bromine extracts all the iodine from the iodide, and transforms it into a bromide, and that the iodine is capable of reacting on alcoholate of soda, and thus forming an ethereal compound, the action of zinc-ethyl on the hexaiodide was next examined.

Upon mixing the latter with the former in small portions at a time, and gently heating it, a reaction is produced, and a white substance precipitated. When a suitable proportion of iodine (Si_2I_6 for 3ZnEt) has been added, the reaction is finished; it is then distilled, and the distilled product treated with water to decompose a slight excess of zinc-ethyl. After decanting the water, it is repeatedly washed in concentrated sulphuric acid to remove a substance which is soluble in that liquid, and which appears to be triethyl oxide of silicum. It is then again washed with water, dried, and fractionally distilled; two liquids are thus separated; one, boiling at from 150° to 154 , is siliciumethyl, $Si(C_2H_5)_4$; and the other, which was obtained between 250° and 253°, gives, on analysis, numbers agreeing with the formula $Si_2(C_2H_5)_6$. It is a limpid liquid, with a faint smell, resembling that of siliciumethyl and burns with a brilliant flame, giving forth fumes of silica. Upon ascertaining the density of vapour, the figures obtained approached very nearly to those required by the theory for the formula $Si_2(C_2H_5)_6$, but somewhat higher (theory 7·96 exp. 8·5). The liquid does not alter sensibly at 300°, but alters slightly, with formation of a product soluble in sulphuric acid, which is doubtless triethyl oxide of silicium, $Si_2O(C_2H_5)_6$, which is formed by oxidation of siliciumhexethyl. The presence of this body expains the slight excess of the found density as compared with the theoretical density. The exactitude of the formula, $Si_2(C_2H_5)_6$, is beyond doubt; consequently the series of compounds here spoken of certainly belong to the ethylic group of silicium. The two atoms of silicium are directly connected, and serve as a link to the atoms of iodine, or of oxygen and hydroxyl, or ethyl, which combine with them to form the molecule. The reaction of the zinc ethyl upon the hexaiodide takes place in an exactly similar manner to that of the same body upon the chloride and the iodide of silicium, and furnishes a compound which may be considered as homologous with siliciumethyl. The study of the reactions of this body will doubtless be interesting, and will probably show that the analogy is not confined to the formulæ.—*Comptes Rendus.*

ON THE COMPOSITION OF THE WATER OF THE IRISH SEA.*

BY T. E. THORPE, PH.D., AND MR. E. H. MORTON.

Thanks to the investigations of Forchhammer, Von Bibra, Bischof, and others, our knowledge concerning the nature and distribution of the saline constituents of sea-water and of the causes of the variations in its composition as observed in various parts of the world, is tolerably extensive and precise. English chemists, however, have contributed next to nothing to the general stock of our information on this subject. This is not a little remarkable, especially when we consider the peculiarly favourable condition in which this country is placed for researches of this kind, by reason of its insular position. A few observations by John Davy made in the course of his long voyages, two memoirs by Marcet in the "Philosophical Transactions" for 1819 and 1822 on the temperature and saltness of various seas, and an elaborate analysis by Schweitzer of the water of the English Channel made in 1838, constitute by far the chief portion of the work done in this direction by English chemists. The chemical history of the sea is mainly to be derived from the researches and observations of chemists principally French and German, the majority of whom are located at considerable distances from the sea-board, and who laboured therefore under all the disadvantages which this circumstance necessarily entails. So far as we can learn the water of the Irish Channel has never been analysed. We have been induced, therefore, to undertake its analysis in the hope of supplying information respecting the nature and extent of the modifications effected in the composition of the sea by its proximity to our coasts. Accordingly

* Read before the Manchester Literary and Philosophical Society, March 22, 1870.

Captain Temple of the "Bahama Bank" Light Ship kindly collected for us a quantity of the water in the immediate neighbourhood of his vessel. The vessel is situated in lat. 54° 21′ N. and long. 4° 11′ W., seven miles W.N.W. of Ramsey, Isle of Man, and is placed nearly equi-distant from the shores of England, Scotland, and Ireland. During the greater part of the day a strong current setting in from the south, probably from the Atlantic, flows past the ship into the North Channel, and thence again into the Ocean. The water, therefore, taken for analysis, was originally that of the deep ocean, which had traversed almost the entire length of the Irish Channel, and had consequently been exposed to all the influences due to the neighbouring sea-board, and to the influx of the numerous rivers along the coasts.

The water was obtained in the early part of January, 1870; the meteorological conditions at the time of collection, and for some time previously, were in no wise remarkable. The analysis was commenced immediately on receipt of the water. Its specific gravity compared with distilled water, free from air, and possessing the same temperature, was found to be—

At 0° C.	1·02721
At 15° C.	1·02484

These numbers differ but slightly from that usually accepted as representing the mean specific gravity of the water of the ocean. The water of the Atlantic, according to Von Horner, possesses the specific gravity 1·02875 at 0° C.; that of the English Channel at 15·5° was found by Schweitzer to be 1·0271: on nearing the land the specific gravity fell to 1·0268.

Full details of the methods of analysis employed are given in the original paper. The following synopsis shows the mean results of the determinations: the numbers express the amount of the various ingredients in 1000 grms. of the sea-water.

1 Chlorine	18·62650
2 Bromine	0·06133
3 Sulphuric acid (SO_4)	2·59280
4 Lime (total)	0·57512
5 Calcium carbonate	0·04754
6 Magnesia	2·03233
7 Mixed alkaline chlorides	27·18363
8 Potassium	0·39131
9 Sodium	10·40200
10 Ferric oxide	0·00465
11 Ammonia	0·00011
12 Nitric acid	0·00156
13 Fixed constituents	33·83855

These substances, arranged on the assumption that the strongest acid is united with the strongest base, yield the following numbers:—

Sodium chloride	26·43918
Potassium chloride	0·74619
Magnesium chloride	3·15683
Magnesium bromide	0·07052
Magnesium sulphate	2·06608
Magnesium carbonate	traces
Calcium sulphate	1·33158
Calcium carbonate	0·04754
Lithium chloride	traces
Ammonium chloride	0·00044
Magnesium nitrate	0·00207
Silicic acid	traces
Ferrous carbonate	0·00503
	33·85946
Amount directly determined	33·83855

The water employed in the foregoing analysis was collected in midwinter. It becomes interesting to know if its composition is uniform during the various seasons of the year. Fortunately we can offer some evidence on this point. In August, 1865, after a continuance of exceptionally fine weather, one of us collected some sea-water in the neighbourhood of the "Bahama Bank" Light Ship, and determined the total quantity of its saline constituents, together with the amount of chlorine and sulphuric acid. The proportion of solid matter contained in the water of the Irish Sea is somewhat greater in summer than in winter—the variation amounting to 0·0144 per cent—but the relative amount of solid matter present in the water of the Irish Channel is invariably less than is contained in the water of the Atlantic Ocean lying between the same parallels.

According to Forchhammer, the mean proportion of the leading constituents of the water of the Atlantic far away from the shores is as follows:—

	Cl.	SO_3.	CaO.	MgO.	Total Salts.
Absolute amount in 1000 grms.	19·865	2·362	0·588	2·199	35·976
Relative amount	100·	11·89	296	11·07	181·10

Arranged in this manner, our determinations on the water of the Irish Sea give the following proportions:—

		Cl.	SO_3.	CaO	MgO.	Total Salts.
Absolute amount per 1000 grms.	Summer.	18·735	2·187	—	—	34·082
	Winter.	18·627	2·161	0·575	2·032	33·838
Relative amount.	Summer.	100	11·67	—	—	181·91
	Winter.	100	11·63	3·09	10·93	182·09

RESEARCHES ON VANADIUM.*

Part III. Preliminary Notice.

BY HENRY E. ROSCOE, B.A., F.R.S.

I. Metallic Vanadium.

In the second part of "Researches on Vanadium," it was stated that the metal absorbs hydrogen. This conclusion has been fully borne out by subsequent experiment: and it appears that the amount of absorbed or combined nitrogen taken up by the metal varies according to the state of division—first, of the chloride (VCl_3) from which the metal is prepared, and secondly, and especially, of the metal itself. The metal containing absorbed hydrogen slowly takes up oxygen on exposure to the air, water being formed and the metal undergoing oxidation to the lowest oxide, V_2O. At this point the oxidation stops.

The difficulty of obtaining metallic vanadium free from admixture of oxide has been again rendered evident. Perfectly pure tetrachloride was prepared in quantity, and from this pure dichloride was made. On heating this to whiteness for forty-eight hours, a substance was obtained which gained, on oxidation, 70·7 per cent (vanadium requiring 77·79 percentage increase), and, therefore, still contained a slight admixture of oxide.

The reducing action of sodium on the solid chlorides was next examined; in this case, the reduction takes place quietly in an atmosphere of hydrogen at a red heat, and is best conducted in strong iron tubes. Explosions occur when sodium acts on the liquid tetra-

* Read before the Royal Society, April, 1870.

chloride. The substance thus obtained was found, after lixiviation, to be free from chlorine, and on washing it separated into two portions—(1) a light and finely-divided black powder (trioxide), which remains in suspension, and is soluble in hydrochloric acid; and (2) a heavier grey powder, insoluble in hydrochloric acid, which soon deposits, and can, by repeated washing, be completely freed from the lighter trioxide. This bright grey powder consists of metallic vanadium, mixed with more or less oxide. If this metallic powder, after drying *in vacuo*, be reduced at a low red heat in a current of pure hydrogen, the powder, even when cold, on exposure to air or oxygen, takes fire spontaneously, water being formed, whilst the vanadium undergoes oxidation, forming the blue oxide, V_2O_4. A portion of metal exposed for some weeks to the air also slowly absorbed oxygen, pasing into the oxide, V_2O.

II. Vanadium and Bromine.

1. *Vanadium Tribromide*, VBr_3; molec. wt. = 291·3.—When excess of bromine is passed over vanadium mononitride heated to redness, a vivid action occurs, and dense dark-brown vapours are formed, condensing in the cooler portions of the tube to a greyish black, opaque, amorphous mass of the tribromide. The tribromide is a very unstable compound, losing bromine even when kept sealed up in glass tubes; it is very deliquescent, and, on heating in the air, rapidly loses all its bromine and takes up oxygen, with formation of vanadic acid. On being thrown into water, the tribromide readily dissolves, forming a brown liquid (in this respect resembling the trichloride), which, on addition of a few drops of hydrochloric acid, turns of a bright green colour, showing the presence of a solution of an hypovanadic salt. No free bromine or hydrobromic acid is given off on dissolving the tribromide in water. That a more volatile higher bromide was not formed in this reaction was shown, inasmuch as, on distilling the excess of liquid which had collected in the receiver, it was found to consist of free bromine, containing mere traces of the tribromide mechanically carried over. The tribromide is likewise formed when bromine is passed over a red-hot mixture of vanadium, trioxide, and pure charcoal, as in the preparation of the tetrachloride; but this method is not one to be recommended, as the tube becomes constantly stopped up by the formation of the solid tribromide.

The analysis of the tribromide was made by dissolving the compound in water, and precipitating the bromine with excess of nitrate of silver, the vanadium being estimated as V_2O_5, either in the filtrate from the bromide of silver or in a separate portion. The bromine in the above determinations, obtained by precipitation as silver-salt, was invariably found to be too high, whilst the vanadium nearly agreed with the theoretical percentage. This is due to the fact pointed out by Stas, in his "Recherches" (p. 156), that bromide of silver, when boiled, encloses, mechanically, a portion of the precipitant, which then cannot be washed out. The loss of weight obtained by reducing the bromide to metallic silver in a current of hydrogen, taken as bromine, gave more nearly agreeing numbers:—

		Calculated.	Mean of 6 determinations.
Vanadium.....V	= 51·3	17·61	18·44
			Mean of 3 determinations.
Bromine.....Br_3	= 240·0	82·39	80·86
	291·3	100·00	99.30

2. *Vanadium Oxytribromide*, or *Vanadyl Tribromide*, $VOBr_3$, molec. wt.=307·3.—The oxytribromide is a dark-red transparent liquid, evolving white fumes on contact with the air, obtained by passing pure and dry bromine over vanadium trioxide (V_2O_3) heated to redness. Moisture prevents the formation of the oxytribromide; and it not only undergoes sudden decomposition when heated to 180°, but also slowly decomposes at the ordinary atmospheric temperatures. The boiling-point of the tribromide can, however, be brought below the temperature of decomposition by distillation *in vacuo*, and the liquid can then be freed completely from bromine by passing a current of dry air through the liquid. Under a pressure of 100 m.m., the oxytribromide boils from 130° to 135, and may be distilled almost without decomposition. Vanadium oxytribromide dissolves in water, yielding a yellow-coloured solution, in which both vanadium and bromine were determined, after reduction with sulphurous acid—

		Calculated.	Mean of several analyses.
V.....	= 51·3	16·69	16·75
Br_3.....	= 240·0	78·10	79·20
O.....	= 16·0	5.21	——
		100·00	

The sp. gr. of the oxytribromide, at 0°, is 2·967.

3. *Vanadium Oxydibromide*, or *Vanadyl Dibromide*, $VOBr_2$, molec. wt.=227·3.—This is a solid substance, of a yellowish-brown colour, obtained by the sudden decomposition of the foregoing compound at temperatures above 100°, or by its slow decomposition at the ordinary temperature.

The oxydibromide is very deliquescent, dissolving in water, with formation of a blue solution of a vanadious salt. When heated in the air, it loses all its bromine, and is converted into V_2O_5.

Analysis gave—

		Calculated.	Mean of several analyses.
V.....	= 51·3	22·570	22·45
Br_2.....	= 160·0	70·390	70·93
O.....	= 16·0	7·104	——
	227·3	100·000	

III. Vanadium and Iodine.

Iodine vapour does not attack either the trioxide or the nitride at a red heat; both these substances remain unchanged, and no trace of vanadium can be detected in the iodine which has passed over them.

IV. The Metallic Vanadates.

In the first part of these Researches (*Phil. Trans.* 1868), it was pointed out (1) that the salts analysed by Berzelius must be considered as meta- or mono-basic vanadates, (2) that the so-called bivanadates analysed by Von Hauer are anhydro-salts, and (3) that the ortho- or tribasic vanadates contain 3 atoms of monad metal, the sodium salt being formed artificially by fusing 1 molecule of vanadium pentoxide with 3 molecules of carbonate of soda, when 3 molecules of carbon dioxide are expelled, whilst the orthosalts occur native in many minerals. The present communication contains a description of these classes of salts, as well as of a new class of salts, the tetrabasic or pyro-vanadates.

Sodium Vanadates.

1. *Ortho-* or *Tri-Sodium Vanadate*, $Na_3VO_4 + 16H_2O_2$.—When a mixture of 3 molecules of Na_2CO_3 and 1 mole-

cule of V_2O_5 is fused until no further evolution of CO_2 is observed, a tribasic vanadate remains as a white crystalline mass. This mass dissolves easily in water, and on addition of absolute alcohol to the solution two layers of liquid are formed; the lower one solidifies after a time, forming an aggregation of needle-shaped crystals, which possess a strongly alkaline reaction. These having been washed with alcohol, and dried on a porous plate over sulphuric acid *in vacuo*, were analysed with the following results:—

		Calculated.	Found.
Na_3	= 69·0	14·6	13·80
V	= 51·3	10·86	10·86
O_4	= 64·0	13·56	—
$16H_2O$	= 288·0	60·97	60·44
	472·3	99·99	

The sodium in this and in the following compounds was separated from the vanadium by precipitating the vanadic acid as the perfectly insoluble basic lead salt hereafter described. This was dried at 100° and weighed, then dissolved in nitric acid and decomposed by sulphuric acid, and the solution of V_2O_5 in excess of this acid gave, on evaporation, a finely crystalline mass. The filtrate from the lead precipitate freed from lead yielded on evaporation sodium sulphate. Full analytical details of this method, as well as of the other by precipitation, as the insoluble ammonium metavanadate, are given in the memoir. By frequent crystallisations the tri-sodium vanadate is slowly decomposed into the tetrasodium salt, caustic soda being formed. This singular reaction was most carefully examined and the amount of sodium hydroxide liberated determined diametrically.

2. *Tetrasodium Vanadate*, $Na_4V_2O_7 18H_2O$.—This salt crystallises in beautiful six-sided tables. It is easily soluble in water, insoluble in alcohol, and is precipitated by the latter liquid from aqueous solution in white scales of a silky lustre. As long as the salt contains free alkali or tribasic salt, it forms, on precipitation with alcohol, oily drops which solidify after some time. The tetrasodium vanadate is always formed by the first fusion of vanadic acid with excess of carbonate of soda, and can be easily prepared in the pure state by re-crystallisation.

		Calculated.	Found (mean of several determinations).
Na_4	= 92·0	14·58	14·61
V_2	= 102·6	16·27	15·97
O_7	= 112·0	17·27	—
$18H_2O$	= 324·0	51·38	51·80
	630·6	99·99	

The salt loses 17 molecules of water at 100°.

The corresponding Calcium and Barium Vanadates, $Ca_2V_2O_7$, and $Ba_2V_2O_7$ are white precipitates obtained by adding the chlorides to a solution of tetrasodium vanadate. If calcium chloride be added to a solution of the trisodium salt, dicalcium vanadate is precipitated, the solution becoming strongly alkaline from formation of calcium hydroxide and absorbing carbonic acid from the air. Complete analysis showed that the calcium salt contains $2\frac{1}{2}$ molecules of water of crystallisation, whilst the barium salt is anhydrous.

Lead Vanadates.

1. *Tribasic* or *Ortho-Lead Vanadate*, $Pb_3\,2(VO_4)$.—Obtained as a light yellow insoluble powder on precipitating the tribasic sodium salt with a soluble lead salt; it yielded on analysis 11·75 per cent of vanadium, the calculated quantity being 12·04 per cent.

2. *Vanadinite, the Double Ortho-vanadate and Chloride of Lead*, $3Pb_3VO_4+PbCl_2$, can be artificially prepared by fusing for a few hours a mixture of vanadic acid, oxide of lead, and chloride of lead, in the above proportions, together with an excess of sodium chloride. After cooling, a greyish crystalline mass is left, containing cavities filled with long crystals having the same colour as the mass, which under the microscope could be distinguished as six-sided prisms. The crystalline powder is then boiled with water until no further traces of soluble chlorides are extracted.

The following analysis shows that this substance has the same composition as the vanadinites from Zimapan and Windischkappel, analysed by Berzelius and Rammelsberg.*

	Calculated. $3(Pb_3VO_4)PbCl_2$.	Natural vanadinite. Zimapan, Berzelius.	Windischkappel, Rammelsberg.	Artificial. vanadinite.
Lead	73·08	70·40	71·20	71·96
Vanadium	10·86	—	9·77	11·11
Chlorine	2·50	2.54	2·23	2·31
Oxygen	13·55	—	—	—

The specific gravity of the artificial vanadinite at 12° C. is 6·707, that of the natural being 6·886.

3. *Basic Di-Lead Vanadate*, $2(Pb_2V_2O_7)+PbO$.—Acetate of this salt is precipitated as a pale yellow powder when lead is added to a solution of disodium vanadate, the liquid acquiring an acid reaction. It is completely insoluble in water and in dilute acetic acid, but dissolves readily in nitric acid.

		Calculated.	Mean found.
Pb_5	= 1035·0	69·92	70·18
V_4	= 205·2	13·86	13·30
O_{15}	= 240·0	16·22	—
	1480·2		

Silver Vanadates.

1. *The Ortho-silver Vanadate*, Ag_3VO_4, is obtained as an orange-coloured precipitate by mixing a freshly prepared solution of the trisodium salt with a solution of silver nitrate, in which every trace of free acid has been neutralised; unless these precautions are attended to, the precipitate consists of a mixture of the ortho- and pyro-salt. The tri-silver vanadate is insoluble in water, but readily dissolves in ammonia and nitric acid. Analysis gave the following results:—

		Calculated.	Found (mean).
Ag_3	= 324·0	73·75	73·83
V	= 51·3	11·67	11·76
O_4	= 64·0	14·58	—
	439·3	100·00	

2. *The Tetrabasic Silver Vanadate*, $Ag_4P_2O_7$, is prepared by mixing a solution of the corresponding sodium salt with a neutral solution of nitrate of silver. It falls as a yellow dense crystalline precipitate, resembling in colour the ordinary phosphate of silver. On dissolving the salt in nitric acid, the silver is precipitated as chloride, and the vanadium determined as V_2O_5.

Analysis gave:—

		Calculated.	Found.
Ag_4	= 432·0	66·81	66·45
V_2	= 102·6	15·87	15·97
O_7	= 112·0	17·32	—
	646·6	100·00	

* Pyromorphite and apatite have already been artificially prepared by Deville and Caron, and also by Debray, whilst mimetesite has been obtained artificially by Lechartier.

I have to thank Messrs. Œhofer and Finkelstein for the valuable assistance which they have given me in the above investigation.

NOTE ON THE

DOUBLE ARSENIATE OF MAGNESIA AND AMMONIA.

BY FREDERICK FIELD, F.R.S.

Many years ago I published in the *Quarterly Journal of the Chemical Society*, vol. xi., p. 6, a paper "On the Composition of the Double Arseniate of Ammonia and Magnesia," after a long investigation of the subject. Mr. E. W. Parnell in the Chemical News (vol. xxi., p. 133; *Am. Reprint, May, '70, page* 256), has also written an elaborate memoir on the same substance, and he arrives at the conclusion that at about a temperature of 90° C. ammonia escapes, but more than one equivalent of water is retained, while at a temperature of from 100° to 110° C. this excess of water, and probably more ammonia are driven off, and, therefore, considers that no definite compound of arsenic can be obtained by drying the precipitate at a temperature at all suitable for counterpoised filter.

Without impugning for one moment the accuracy of Mr. Parnell's analyses, my own experiments seemed so fully to corroborate the excellence of Levot's method for the estimation of arsenic by the formation of the double arseniate, recognised as most satisfactory both by H. Rose and Fresenius, and recommended by those chemists, that I was led to study Mr. Parnell's experiments attentively to see if our methods of working were identical. In referring to the *Quarterly Journal of the Chemical Society*, vol. xi., p. 13, it will be found that it is very necessary to be extremely cautious in the desiccation of the substance in question. Specimens dried upon a filter placed above a sand bath with a thermometer suspended at the same distance from the heated surface (the mercury never rising above 300° F.) were found to have lost the whole of their water in from four to five hours, and from more recent experiments it has been proved that no water can exist even at 230° F. Again, it is stated on the same page, "like the corresponding lime salt, it loses water at a slight increase of temperature (the lime salt loses its equivalent of water at a little above 212° F.)."

Now, upon a careful perusal of Mr. Parnell's paper it appears that a *constant* temperature of 100° C., except in one instance, was not employed, the thermometer ranging from 90° to 100° C. He is, therefore, quite correct in saying that at 90° more than one equivalent of water is retained (*vide Quarterly Journal of the Chemical Society*, vol. xi., p. 13), and also that from 100° to 110° C. the excess of water is driven off.*

Mr. Parnell obtains, in one experiment, where the arsenic has been thoroughly oxidised by the passage of chlorine through the arsenic acid solution, 0·1690 of arsenious acid from 0·3244 of the double arseniate, a result, he observes, far too low, and which leads him to believe that the formula $(AsO_4,MgNH_4O)2H_2O$ does not represent the composition of the compound after being dried at 100°—110° C. Certainly it does not, for the composition of the double arseniate above 100° C. contains no water, and the calculated quantity of arsenious acid obtained by drying the arsenical compound above 100° C. should be 0·173, not very much above Mr. Parnell's figures. Again, when 1·0152 grms. of air-dried compound were heated in the air bath, at a temperature of 100°—110°, the mean loss by weight in three experiments gave Mr. Parnell 37·86 per cent. In my experiments the loss was 37·41, no very great discrepancy, when reduced to percentages.

With regard to the evolution of ammonia at temperatures under 100° C., I confess it is a matter of grave interest, and has escaped the observation of all former analysts. Rose himself has given the formula of the compound dried at 100° $(NH_4O,2MgOAsO_5)HO$ (old notation), and this has been corroborated by many chemists. I have always noticed the smell of ammonia, and its action upon litmus, when drying the substance, but concluded that it arose entirely from the liquid in which the precipitate was washed upon the filter, and which was always made strongly alkaline, as the double arseniate is far more insoluble in ammonia than in either water or chloride of ammonium.

Mr. Parnell's experiments, therefore, in some respects coincide with my own, inasmuch as he proves that under 100° C. more than one equivalent of water exists, and that above that temperature, according to his own figures (with a slight margin for necessary error), no water exists.

ON CONSECUTIVE POLES IN A MAGNET.

BY CHARLES TOMLINSON, F.R.S.

In the Chemical News (vol. xxi., p. 164; *Am. Repr., June, '70, page* 343) is an account, by Mr. Porter, of some "curious results in the shape of magnetic phenomena." These results refer to the production of what are called, by English writers on magnetism, *consecutive poles;* by the French, *points conséquens;* and, by the Germans, *Folgepunkte.* Although the phenomena which accompany their production are interesting and instructive, they are scarcely noticed in the modern treatises that are in general circulation. Snow Harris, in his "Rudimentary Magnetism," does not describe them, probably for the reason given by Becquerel ("Traité de l'Electricité," vol. i., p. 73)—that a needle containing consecutive points is worthless in observations on terrestrial magnetism. Some of the old treatises give a sufficient account of them; thus, in Cavallo's "Treatise on Magnetism" (second edition, 1795), the following passage occurs at p. 186:—"The magnetic centre, or the limit between the polarities, is not always in the middle of the bar; it is generally nearer that end which is presented to the magnet. This difference is greater as the magnet is weaker and the length of the bar increases; but, when the bar exceeds a certain length (which depends on the strength of the magnet), then the bar acquires several successive poles—viz., when the north pole of the magnet is contiguous to one of its extremities, that extremity becomes a south pole; a few inches farther on you will have a north polarity; then another south polarity, and so on. In this case, the first magnetic centre comes very near that end of the bar which stands next to the magnet, and other magnetic centres are formed between every pair of successive poles: those successive poles become weaker and weaker in power, according as they recede from that end of the bar which is contiguous to the magnet; so that, in a pretty extended bar, they quite vanish long before they come to the farther end of it. Hence, if one pole of a magnet be applied to the end of a long bar, the other end of the bar will not thereby acquire any magnetism."

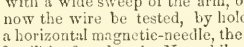
* In Mr. Parnell's paper, "the excess of water and probably more ammonia."

[English Edition, Vol. XXI., No. 543, page 185; No. 544, page 193.]

An effect of this kind may be well shown by magnetising one-half only of a steel knitting-needle about nine inches long.

Experiment 1.—Place a steel knitting-needle on the table, and press it down firmly, by means of a finger, in the middle of its length; then draw the south pole of a strong magnet along the wire, from the finger to the end, about six or eight times, bringing the pole, after each touch, with a wide sweep of the arm, back to the finger. If now the wire be tested, by holding it vertically near a horizontal magnetic-needle, the end of the touched half will be found to be N.; while the S. pole will be somewhere within the wire, at about 5 inches from the N. pole, and the rest of the wire inactive. On dipping the N. end into iron-filings, a considerable bunch will be taken up. On dipping the other end into the filings, it will attract none of them, until the filings reach the wire at and about S. (Fig. 1), where a large bunch will be taken up.

Fig. 1.



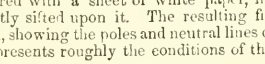
This experiment may be varied by rubbing the N. or S. pole of a strong magnet over about an inch or two of the central portion of a knitting-needle 9 inches long. All three poles will be within the wire, an inch or more at each end being magnetically inactive.

The following experiment will show the action of consecutive poles:—

Experiment 2.—A bar-magnet, 6 inches long and $\frac{1}{2}$ inch wide, was touched six times on its marked or northern half with the north end of a strong magnetic battery. On passing the bar horizontally before a small dipping-needle, the marked end of the bar strongly attracted the marked end of the needle. At the distance of $1\frac{1}{2}$ inches from the marked end of the bar, the needle suddenly swung round, and presented its S. pole to the bar, and continued to do so until a part of the bar, $1\frac{1}{4}$ inches from the other end, arrived opposite the needle, when this again swung round, and presented its N. pole to the bar for the remainder of its length.

Experiment 3.—The bar being placed on the table, and covered with a sheet of white paper, iron-filings were gently sifted upon it. The resulting figure was very good, showing the poles and neutral lines distinctly. Fig. 2 represents roughly the conditions of the case—

Fig. 2.



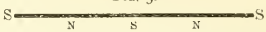
A similar case being produced in a knitting-needle—

Experiment 4.—The needle was broken in the middle, when each fractured end remained a N. pole, the other two ends S. poles, and the neutral point was in the centre of each fragment.

Although, theoretically, the pole is a point situated some way within each end of the bar, in which point all the forces of one kind or other are supposed to be collected (just as the centre of gravity is a point within a body in which all the weight is supposed to be collected), yet, in practice, each half of the bar is often referred to as a pole; and, in the case before us, a considerable portion of the centre of the long wire may be taken as a north pole, bounded on either side by a neutral line, and by a considerable portion of each end which forms a south pole. The extent of north pole in the central portion of the wire is such that it may (as in Experiment 4) be cut through without disturbing the arrangement, each half being now a complete magnet, with the poles and neutral line arranged exactly as they were before the separation; and, further, when the severed ends are brought together, and iron-filings dusted over the whole length, the same figure is produced as before the separation.

Experiment 5.—A knitting-needle was placed on white paper, and the first quarter of its length rubbed with the north pole of a bar-magnet, the second quarter with the south pole, the third with the N., and the fourth with the S. The result of this operation was a needle with five poles—

Fig. 3.

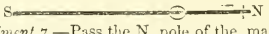


Consecutive poles are due to several causes—such as an over-exertion of the coercitive force, as when we attempt to saturate a bar of steel of too great a length. According to Coulomb, consecutive poles are always formed in needles of tempered steel, where the length exceeds thirty times the diameter. Or, if the steel be of too hard a temper, or of unequal temper, these points are likely to occur from the unequal distribution of the coercitive force. In some cases, they may be made to disappear by a careful re-magnetisation.

According to Coulomb, the neutral line is always brought some millimetres nearer the part of the bar last touched. This may be roughly but strikingly shown by restoring the bar-magnet (Fig. 2) to its natural condition as to polarity.

Experiment 6.—Pass the S. pole of a powerful magnet three or four times over the marked end of the bar (Fig. 2). The two consecutive poles will disappear; but the neutral point will be at about 2 inches, instead of 3, from the marked end, as in Fig. 4.

Fig. 4.

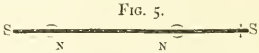


Experiment 7.—Pass the N. pole of the magnet two or three times over the S. end of the bar (Fig. 4), and the neutral point will be at, or very near, the centre.

When a long, magnetised knitting-needle has one of its poles reversed, and two consecutive poles formed, the neutral points are not distributed symmetrically.

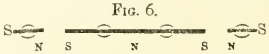
Experiment 8.—Rub the N. pole of the magnet over the N. end of the needle about three times. The needle will have a S. pole at each end, and the N. pole spread over the centre. The neutral lines will be at $1\frac{3}{4}$ inches from the original S. pole, and $2\frac{1}{2}$ inches from the reversed N. pole, as in Fig. 5.

Fig. 5.



Experiment 9.—Cut off the two ends of Fig. 5 a little on the S. side of each neutral line. The central portion will be constituted as before—viz., with two extreme S. poles and two inner N. poles, only the neutral points will be brought nearer together. Each of the end fragments is a perfect magnet, with the S. poles undisturbed and the N. poles at the fractured ends, the neutral point being in the middle. Each end of the central piece will lift each fragment by the broken end, and the three pieces being put together in proper order appear thus:—

Fig. 6.



Experiment 10.—Rub N. pole of battery over the N. end of one of the short pieces ($2\frac{1}{2}$ inches long) marked

S. N. The effect is simply to reverse the poles, without producing consecutive ones.

If a similar experiment be performed on a regularly magnetised wire not under about 4 inches long, the effect will not, in general, be simply to reverse the poles, as in Experiment 10, but to produce a pole of the same name at each end, while the pole of opposite name occupies the middle portion of the wire, as in Figs. 2 and 5, and the central portion of Fig. 6. Only it must be observed that, in magnetised pieces of steel wire of about 4 inches in length, the end rubbed with the pole of a strong magnet may so far disturb the arrangement of the neutral lines that one may come very near one end, so as to make it somewhat difficult to detect the two poles which such line separates, at least by the dipping-needle or horizontal magnet test. The figure formed by gently dusting iron-filings over it is an elegant and good test.

Experiment 11.—A magnetised wire, $4\frac{1}{2}$ inches long, had its northern half rubbed with the N. pole of a strong magnet. Fig. 7 represents the magnetic wire before this treatment, and Fig. 8 the result of the treatment. It will be seen from Fig. 8 that the neutral point on the side rubbed is $1\frac{1}{2}$ inches from the rubbed end, while the other neutral point is only $\frac{3}{8}$ inch from the other end.

Fig. 7.

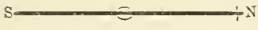
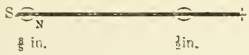


Fig. 8.



I trust the majority of the readers of the Chemical News will excuse the rudimentary nature of the foregoing details into which I have been tempted by what I think are the insufficient descriptions of Mr. Porter. The student may find amusement and instruction in repeating and devising such experiments as have been described. The apparatus required does not necessarily consist of more than a sixpenny horseshoe-magnet, a small compass-needle, a few thin steel knitting-needles, some iron filings contained in a gauze bag or in a small sieve, and a sheet or two of writing-paper. In order to bring out the effects strongly, I used a magnetic battery, capable of lifting about 20 lbs. weight, for magnetizing the wires, and a small, delicately-poised dipping-needle for testing them; but nothing can be more graphic than the iron filings test, and the filings may be gently dusted on the wire itself or on the white paper placed upon it, assisting the figure, if necessary, by a few taps under the table.

Highgate, N., April 18th, 1870.

ON

NITRIC ACID AND CHLORATE OF POTASSIUM

AS AN

OXIDISING MIXTURE APPLICABLE TO SULPHUR, SULPHIDES, CHROMIUM, ARSENIC, ORGANIC MATTERS, &C.

BY FRANK H. STORER,

PROFESSOR OF GENEREAL AND INDUSTRIAL CHEMISTRY IN THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

Some years since, while studying the action of various oxidising agents upon oxide of chromium, I was struck by the superior oxidising power of a mixture of ordinary nitric acid and chlorate of potassium over that of the mixtures of chlorate of potassium and chlorhydric or sulphuric acid commonly used in analysis. Inasmuch as the fact of the great oxidising power of a mixture of nitric acid and the chlorate had already been noticed and explained by several observers,* I at that time contented myself with a simple statement of my own observations of the action of the mixture upon chromic oxide,† without referring in any way to the general value of the mixture as an oxidising agent. Since that time, however, I have had frequent occasion to employ the mixture for effecting the oxidation of many substances besides oxide of chromium, such as present themselves in the ordinary experience of an analytical laboratory, and have satisfied myself that the merit of the process has not hitherto been duly appreciated.

Experience has convinced me, not only that a mixture of nitric acid and chlorate of potassium oxidises more rapidly than the common mixture of chlorhydric acid and chlorate of potassium, but that it is really to be preferred, in the great majority of cases, to any of the agents ordinarily employed to effect oxidation in the wet way. Instead of occupying, as now, a secondary or alternative place in the treatises on analysis, it ought to take precedence of the other processes of oxidation. It may be used with advantage in many instances where dry methods of oxidation are now recommended. With the exception, perhaps, of the sulphides or other compounds of antimony and tin, there are probably but few cases where its use will be found inadmissible.

The following notes include the results of several researches made by students of the Massachusetts Institute of Technology with the view of testing the capabilities of the process:—

Estimation of Sulphur in Organic Compounds. By A. H. Pearson.

It is easy to determine sulphur in non-volatile organic compounds, by oxidising the substance with chlorate of potassium and nitric acid, precipitating the sulphuric acid as sulphate of barium, and washing the latter with a solution of acetate of ammonium, to remove any nitrate of barium which may have adhered to it.

To oxidise the sulphur compound, place a weighed quantity of it in a porcelain dish, pour upon it three or four table-spoonfuls of strong nitric acid (39° B.), free from sulphuric acid, and add to the acid half a tea-spoonful of chlorate of potassium. Cover the mixture with an inverted glass funnel, the stem of which has been bent to a right angle. Place the dish on a wire-gauze support, and heat its contents. From time to time, lift the funnel slightly, and throw a small fragment of chlorate of potassium into the hot acid.

The funnel must be of such size that its rim may fall within the rim of the dish, and rest securely upon the sides of the dish, above the liquid. It serves to retain the particles of liquid which are thrown up from the dish by the gas evolved during the decomposition of the chlorate.

The oxidation will be completed more or less rapidly, according to the character of the substance operated upon. Only five or ten minutes are required to completely oxidise a third of a gramme of sulphocyanide of

* Compare Gmelin's "Handbook of Chemistry," vol. iii., p. 62.
† *Proceedings of the American Academy*, 1859, vol. iv., p. 342; *Journal fur Praktische Chemie*, vol. lxxx., p. 44.

potassium, while from half to three-quarters of an hour are needed to destroy the same weight of ordinary free sulphur. It may be observed, in passing, that sulphur which has just been distilled dissolves twice as rapidly in a mixture of nitric acid and chlorate of potassium as sulphur which has long been exposed to the air.

Several samples of sulphocyanide of potassium, oxidised in this way, gave the following results:—

A. 0·2015 grm. of the sulphocyanide gave 0·5114 grm. of sulphate of barium. (I.)
A. 0·265 grm. of the sulphocyanide gave 0 6547 grm. of sulphate of barium. (II.)
B. 0·149 grm. of the sulphocyanide gave 0·3796 grm. of sulphate of barium. (I.)
B. 0·012 grm. of the sulphocyanide gave 0·03 grm. of sulphate of barium. (II.)
C. 0·101 grm. of the sulphocyanide gave 0·2387 grm. of sulphate of barium.
D. 0·028 grm. of the sulphocyanide gave 0·067 grm. of sulphate of barium. (I.)
D. 0·084 grm. of sulphocyanide gave 0·204 grm. of sulphate of barium. (II.)

The sulphocyanide used for the experiments mentioned in the paragraphs marked "A" was prepared by fusing together ferrocyanide of potassium, carbonate of potassium, and sulphur, in the usual way, treating the fused mass with hot alchohol, and allowing the alcoholic solution to crystallise. That used for the experiments in paragraphs B was prepared in precisely the same way as the foregoing, but at another time. The salt prepared in this way is evidently contaminated with free sulphur, or some sulphur compound other than the sulphocyanide which has been taken up by the alcohol.

The experiment recorded in paragraph C was made with crystals which separated from the alcoholic mother-liquid of B.

The experiments marked D were made with purified crystals, obtained as follows:—A quantity of the crude alcoholic crystals, similar to those used in experiments B, was dissolved in water; the solution was filtered to separate sulphur, and placed under a bell glass, over strong sulphuric acid, to crystallise. The crystals thus obtained were re-dissolved in alcohol, the solution filtered to separate carbonate of potassium, then concentrated by evaporation, and made to crystallise. The crystals were quickly pressed between folds of filter-paper, and portions of them were weighed out for the analyses.

The crystals obtained directly from the aqueous solution of the sulphocyanide were contaminated to a considerable extent with carbonate of potassium; but, after they had been re-crystallised from alcohol, only traces of the carbonate were found upon them.

Stated in terms of per cents, the results may be tabulated as follows:—

		Found. I.	Found. II.	Theory.
A.	Impure crystals	34·85	33·91	
B.	Impure crystals	34·98	34·33	
C.		32·45	—	
D.		32·85	32 86	32·90

I have applied the foregoing method, not only to sulphocyanide of potassium and to free sulphur, as above described, but also for estimating sulphur in vulcanised caoutchouc, and in several samples of anthracite and bituminous coal. It is easy to completely oxidise either of these substances by means of the mixed chlorate of potassium and nitric acid. Anthracite dissolves even more readily than bituminous coal, since, unlike the latter, it does not fuse to a single mass in the hot acid.

It is not improbable that, by a slight variation of the foregoing process, it may be found practicable to determine the carbon of an organic compound at the same time as the sulphur. Thus, the oxidation might, perhaps, be effected in a flask, provided with a wide funnel-tube for the addition of the chlorate, and a delivery-tube through which the carbonic acid formed could be led into baryta-water or some other substance fit to absorb that gas. Upon this point, however, I have as yet made no experiments.

May, 1869.

Assay of Sulphur in Iron Pyrites. By A. H. Pearson.

The proportion of sulphur in iron pyrites ("sulphur-ore") may be readily and accurately estimated as follows:—Weigh out 1 grm. or less of the powdered ore, place the powder in a porcelain dish, together with a small quantity of chlorate of potassium, pour upon it some 50 c c. of pure nitric acid of 39° B., and cover the mixture with an inverted glass funnel with bent stem. Set the dish upon a water-bath, and heat the water to boiling. From time to time throw crystals of chlorate of potassium into the hot acid. By adding rather large crystals of the chlorate at frequent intervals, it is easy to oxidise the whole of the sulphide in half an hour; but, since the solution obtained in that case is highly charged with saline matter, it will usually be found more advantageous to use less of the chlorate of potassium, and to allow a somewhat longer time for the process of oxidation.

When all the sulphur has been oxidised, rinse the funnel with water, and remove it from the dish. Evaporate the liquid to a small bulk, then add to it a little concentrated chlorhydric acid, and again evaporate to absolute dryness, in order to render silicic acid insoluble. Moisten the residue with concentrated chlorhydric acid, mix it with water, and filter to separate silicic acid and gangue.

To the filtrate from the silicic acid add a quantity of solid tartaric acid, about as large as that of the pyrites originally taken; heat the liquid almost to boiling, and add to it an excess of chloride of barium, to precipitate the sulphuric acid. After the sulphate of barium has been allowed to subside, wash it thoroughly by decantation, first with hot water, and afterward with a dilute solution of acetate of ammonium; the latter may be prepared at the moment of use, by mixing ammonia-water and acetic acid. The purpose of the acetate of ammonium is to dissolve any nitrate of barium which may adhere to the sulphate; that of the tartaric acid is to prevent the precipitation of iron compounds together with the sulphate of barium. In an experiment where 0·7 grm. of pyrites was oxidised with chlorate of potassium and nitric acid, and the filtrate from silica was acidulated with chlorhydric acid without the addition of tartaric acid, there was thrown down, on the addition of chloride of barium, a bright yellow precipitate, which became darker-coloured when the solution was boiled. It was not only found to be impossible to wash out the iron with which this precipitate was contaminated, but the consistency of the precipitate was such that it was a difficult matter even to wash away the saline liquor in which the precipitate was formed.

In another experiment, the attempt was made to remove the iron from the filtrate from silica, before adding the barium-salt to throw down the sulphuric acid; but in that case a considerable portion of the sulphuric

acid was dragged down as sulphate of potassium by the iron precipitate, and so lost. The precipitation of the iron was effected, in this experiment, by adding an excess of ammonia-water to the acidulated filtrate from silica, and washing the precipitate for a long time by decantation with boiling water. To prove that the iron precipitate really retained sulphuric acid, a quantity of the precipitate was dried, ignited, and powdered, and the powder boiled with water. The clear liquid thus obtained was acidulated with chlorhydric acid, and tested with chloride of barium. An abundant precipitate of sulphate of barium was at once thrown down.

After the sulphur of the pyrites has been determined by precipitating it from a tartaric-acid solution, as above described, the iron might perhaps be estimated in the filtrate, by one of the new methods of titration with hyposulphite of sodium. I have made no experiments with the hyposulphite, but have failed completely in several attempts to determine the iron as a sulphide by precipitating with sulphide of sodium, as directed by Fresenius. I found it impossible to wash the sticky, slimy mass of sulphide of iron. It is not easy, on the other hand, to destroy the tartaric acid by igniting the dried filtrate from sulphate of barium in a muffle; for, on evaporating this solution, the saline matters with which it is charged continually creep over the edges of the dish.

November, 1868.

Assay of Copper Pyrites. By F. P. Pearson.

The following method of treating copper pyrites has been found more advantageous than the ordinary process of oxidising the mineral with aqua regia, and subsequently evaporating the solution repeatedly with chlorhydric acid, or with sulphuric acid, to expel the last traces of nitric acid:—

Place a weighed quantity of the powdered mineral, together with some chlorate of potassium, in a porcelain dish. (Five grms. of a variety of pyrites containing about 18 per cent of copper was found to be enough for one analysis; and a quantity of chlorate of potassium equal to a small tea-spoonful was added to the ore). Invert a small glass funnel with bent stem in the dish above the pyrites, and pour upon the latter rather more ordinary strong nitric acid than would be sufficient to completely cover the powder. Place the dish upon a water-bath, and, from time to time, throw into it small quantities of chlorate of potassium. The doses of the chlorate must be repeated at frequent intervals, until free sulphur can no longer be seen in the dish. If need be, add nitric acid, also, from time to time, to replace that lost by evaporation.

As a general rule, it is safer and more convenient to heat the mixture on a water-bath than upon sand, though I find that the oxidation of sulphur can be effected more easily and quickly when the mixture of nitric acid and chlorate is heated to actual boiling than at the temperature obtainable by means of a water-bath. When the last particles of sulphur have been destroyed, remove the inverted funnel from the dish, rinse it with water, and collect the rinsings in a beaker by themselves. Allow the liquid in the evaporating-dish to become cold, pour upon it a quantity of ordinary strong chlorhydric acid rather larger than the quantity of nitric acid taken at first, evaporate the mixed solution to dryness, and heat the dry residue to render silica insoluble, in case any silica be present.

Pour water upon the cold residue, and, without filtering the liquor, wash the contents of the dish into the beaker which contains the rinsings of the funnel. Heat the liquid in the beaker nearly to boiling, add to it about 25 c.c. of a strong aqueous solution of ferrous sulphate slightly acidulated with sulphuric acid, and keep the mixture at a temperature near boiling during four or five minutes, in order to destroy the small quantity of nitric acid which has escaped decomposition in spite of the evaporation with chlorhydric acid.

The ferrous salt seldom or never acts instantaneously, but the reducing-action proceeds rapidly and perfectly satisfactorily when once begun. If need be, add more of the ferrous solution, little by little, until the entire contents of the beaker become dark-coloured or almost black and no more gas is disengaged.

In order to be sure that all the nitric acid has been reduced, it is well enough, after the mixture of liquid and solution of ferrous sulphate has been duly heated, to place a drop of the mixture upon porcelain, and test it with ferricyanide of potassium. In general, however, the colouration of the liquor in the beaker, due to the formation of nitrous or hyponitric acid, will be a sufficient indication that the copperas has done its work. The nitrous fumes quickly disappear from the liquid at a subsequent stage of operations when metallic iron is immersed in the solution.

When enough of the ferrous sulphate has been added, filter the mixed solution into a wide beaker, precipitate the copper, in the metallic state, upon a sheet of iron in the usual way, and ignite the copper, in a porcelain crucible, in a current of hydrogen, before weighing it.

By means of the ferrous salt, the last traces of nitric acid may be got rid of far more quickly, conveniently, and certainly, than by the old system of evaporating the pyrites-solution with several successive portions of chlorhydric acid. By treating the pyrites with chlorate of potassium and nitric acid, it is easy to oxidise and dissolve every particle of the sulphur in the mineral, so that no portion of the latter can escape decomposition by becoming enveloped in free sulphur. When aqua regia is used, on the other hand, or a mixture of chlorate of potassium and chlorhydric acid, a certain proportion of sulphur almost invariably remains undissolved, and might easily enclose portions of the mineral, so as to protect them from the solvent action of the acids.

The method of oxidation above described can manifestly be employed with advantage for dissolving many other sulphuretted ores besides copper pyrites.

January, 1869.

Estimation of Sulphur in Sulphide of Mercury. By E. W. Bowditch.

In order to contrast the action of the mixed nitric acid and chlorate of potassium with that of the mixture of chlorhydric acid and chlorate of potassium ordinarily employed by chemists as an oxidising agent, a series of comparative experiments were made upon commercial vermillion.

Eight portions of the vermillion were operated upon, in succession, as follows:—In each instance, about 0·5 or 0·6 grm. of the vermillion was placed in a small glass flask, set in an inclined position upon a wire-gauze support above a lamp. A quantity of nitric acid of 39° B., or of concentrated chlorhydric acid, as the case might be, was poured into the flask; a small quantity of chlorate of potassium was added, and the mixture heated. From time to time, small bits of chlorate of potassium were thrown into the flask, the contents of

which were maintained near the boiling-point until all the sulphur, or as much of it as possible, had dissolved.

In every instance where nitric acid was employed, the vermillion was, in a short time, oxidised and dissolved so completely that no trace of free sulphur could be seen in the liquor. But, when chlorhydric acid was used to decompose the chlorate, there remained, invariably, floating upon the liquid, one or more yellow globules of undissolved sulphur, varying in size from that of a pin's head to a flax-seed. These floating globules could not be destroyed by any practicable amounts of the chlorate and acid; in fact, it may be said to be impossible to destroy such globules with these reagents.

Whenever chlorhydric acid was used, therefore, to decompose the vermillion, the solution obtained had to be filtered, to separate the free sulphur, before the sulphuric acid in the solution could be precipitated as sulphate of barium. The presence of free sulphur is objectionable, not only because time is lost in collecting, washing, drying, and weighing it, but also on account of its liability to enclose and conceal particles of the substance to be analysed, which would be dissolved by the acid if the latter were able to act upon them. The determination of sulphur may thus be rendered incorrect by weighing the undissolved substances with the sulphur.

When nitric acid was used with the chlorate, it happened sometimes, when the proportion of nitric acid was small, that a considerable quantity of saline matter crystallised in the flask; it was found, however, that enough water to re-dissolve this precipitate might be added to the mixture, without impairing to any material extent the oxidising power of the chlorate subsequently added. The acid liquor resulting from the action of nitric acid and chlorate of potassium upon the vermillion was evaporated to dryness on a water-bath, and the residue treated with strong chlorhydric acid, in order to destroy most of the nitric acid before proceeding to precipitate the sulphuric acid with chloride of barium. Before adding the chlorhydric acid to the residue, the latter must be allowed to become perfectly cold, lest the mixture froth violently, and portions of it be thrown out of the flask. After the acid has once been added, however, the mixture may be heated gently without risk of loss.

No matter whether chlorhydric or nitric acid is employed with the chlorate, the solution must at last be largely diluted with water before adding the chloride of barium.

In my experiments, nothing but hot water was employed to wash the sulphate of barium. Naturally enough, it was more difficult to wash, in this way, the precipitates obtained from solutions contaminated with nitric acid than those from the solutions which contained only chlorhydric acid; but, in spite of this disadvantage, and of the long time required to wash out the last traces of nitrate of barium, I have always found that a sulphur determination made by the nitric-acid process requires much less time for its completion than one made by the old way with chlorhydric acid.

In a final trial, made expressly for the purpose of testing this point, the precise times consumed in making each experiment were carefully noted. Two portions of the vermillion were weighed out into flasks, and treated, one with chlorhydric acid and chlorate of potassium, and the other with nitric acid and the chlorate. The portion treated with chlorhydric acid weighed 0·5695 grm., and the other 0·519 grm. The flask containing the sample treated with chlorhydric acid was taken from the fire a few minutes before the last traces of sulphur in the nitric acid flask had been destroyed, and the separation of the undissolved sulphur was proceeded with as rapidly as possible; but, in the end, it was found that eleven hours and three-quarters were required to complete the determination of sulphur in the portion of vermillion treated with chlorhydric acid, while the estimation of sulphur in the other portion, treated with nitric acid, was finished in nine and a half hours. 14·32 per cent of sulphur was found in the portion treated with nitric acid, and 14·25 per cent in the portion treated with chlorhydric acid, instead the 13·79 per cent required by theory.

February, 1868.

Estimation of Chromium as Chromate of Barium. By A. H. Pearson.

As Professor Storer has shown,* chromic oxide is quickly changed to chromic acid when boiled with a mixture of concentrated nitric acid and chlorate of potassium. All the chromium in ½ grm. of hydrate of chromium, or of any of the ordinary chrome salts, can in this way be converted into chromic acid in a few moments; and even compounds as refractory as chrome-iron ore, or oxide of chromium which has been strongly ignited, can be oxidised in less time than would be required to complete their oxidation by the process of fusion ordinarily employed.

As will appear from the experiments which follow, the chromic acid thus formed in the wet way can be readily and accurately estimated in the form of chromate of barium, if care be taken to wash the precipitated chromate with acetate of ammonium, or some other saline solution in which chromate of barium is insoluble.

1. A quantity of anhydrous chromic oxide was prepared, by heating bichromate of potassium with an excess of strong chlorhydric acid until chlorine ceased to be evolved, saturating the acid liquor with ammonia-water, washing and drying the precipitated hydrate, and finally igniting it intensely in a platinum crucible over a blast-lamp.

0·102 grm. of this anhydrous oxide was placed in an evaporating-dish, together with a quantity of nitric acid and some chlorate of potassium, and covered with an inverted funnel with a bent stem. The acid was heated, and fragments of chlorate of potassium were added to it from time to time, until the chromic oxide had completely disappeared. This result was attained in the course of half an hour.

The acid solution was diluted with water, then neutralised with ammonia, and the ammoniacal solution in its turn treated with enough acetic acid to make it slightly acid. After the accidulated solution has become cold, a solution of chloride of barium was added to it in slight excess, and the mixture was left at rest for ten or twelve hours. The precipitated chromate of barium was washed by decantation with a cold solution of acetate of ammonium, then collected on a filter, rinsed with water, dried, heated in a crucible to expel the last traces of water and of the ammonium-salt, and weighed.

The amount of chromate of barium obtained in this experiment was equal to 0·336 grm., which is equivalent to 68·31 per cent of chromium, instead of 68·62 per cent as required by theory.

The precipitate of chromate of barium must be al-

* *Proceedings of the American Academy*, 1859, vol. iv., p. 342.

lowed to stand for some time before filtering, lest it pass through the pores of the filter, and render the filtrate cloudy.

The acetate of ammonium employed for washing serves to dissolve any nitrate of barium or chloride of barium which may have been precipitated with the chromate; it has the further advantage of dissolving less of the chromate of barium than pure water would.

2. A quantity of hydrate of chromium, precipitated from a solution of reduced bichromate of potassium, as in the previous experiment, was dried at 115°, and the proportion of water retained by the dried hydrate was determined once for all by ignition.

0·11 grm. of this dried hydrate, equal to 0·0688 of the anhydrous oxide, was then treated with nitric acid and chlorate of potassium, as in experiment 1. It was found that the oxidation was completed as soon as the acid became hot enough to decompose the chlorate. Less than five minutes were sufficient, in this instance, for the complete conversion of the chromium to chromic acid.

The chromate of barium obtained weighed 0·2286 grm., equivalent to 68·65 per cent of chromium in the oxide taken, instead of the theoretical 68·62 per cent.

3. 0·113 grm. of the dried hydrate, containing 0·0707 grm. of the anhydrous oxide of chromium, was mixed with a quantity of nitrate of magnesium (prepared by dissolving carbonate of magnesium in nitric acid), before the treatment with nitric acid and chlorate of potassium. 0·2346 grm. of chromate of barium was obtained; in other words, 68·60 per cent of chromium, instead of the 68·62 per cent required by theory.

4. 0·114 grm. of the dried hydrate of chromium, containing 0·0713 grm. of the anhydrous oxide, was mixed with nitrate of aluminum (prepared by dissolving hydrate of aluminum in nitric acid), before the treatment with chlorate of potassium. 0·2356 grm. of chromate of barium was obtained; that is to say, 68·31 per cent of chromium, instead of 68·62 per cent.

5. A small quantity of chrome-iron ore was ground to very fine powder, and treated, in a dish, with nitric acid and chlorate of potassium, as above described. At the end of half an hour, that portion of the ore which still remained undissolved was washed with water, dried, fused with a mixture of carbonate of sodium and nitrate of potassium, and the fused mass boiled with water; but the solution thus obtained gave no reaction for chromium when tested for that substance.

It appears, from the foregoing experiments, that chromium can be readily estimated in this way in presence of aluminum and magnesium. The process can doubtless be employed also for separating chromium from iron, cobalt, nickel, and zinc. As a matter of course, special care must always be taken to employ reagents which are absolutely free from any contamination of sulphuric acid.

April, 1869.

On the Use of Chromate of Barium in Quantitative Analysis. By R. H. Richards.

A sample of pure bichromate of potassium, examined simultaneously by three of the students in the Institute's laboratory, for the purpose of determining the percentage of chromium by precipitating that element in the form of chromate of barium, gave the following discordant results (the method of analysis was similar to that described below):—

Name of experimenter.	Grms. of $K_2O,_2CrO_3$ taken.	Grms. of BaO,CrO_3 found.	Percentage of chromium. Found.	Theory.
N. F. Merrill ...	0·516	0·8640	34·67	35·56
F. P. Pearson...	0·500	0·8788	36·38	"
C. E. Avery....	—	—	36·31	"
"	—	—	36·24	"

At the suggestion of Professor Storer, I have examined other portions of the same sample of bichromate of potassium, with the view of discovering, if possible, the sources of error which vitiated the foregoing analyses.

A quantity of the bichromate was heated until it fused, the cold mass powdered and several portions of it, weighing from one to two grms. each, were taken for analysis. Each of the weighed quantities of bichromate was dissolved in distilled water; the solution was heated nearly to boiling, and a lump of acetate of sodium twice the volume of the bichromate of potassium taken was thrown into the hot liquor. Acetic acid was then added to strongly acid reaction, and afterwards a solution of chloride of barium, with occasional stirring, until no more precipitate was formed on the further addition of chloride of barium and until the supernatant fluid became absolutely colourless. It is easy to hit this point in a hot solution but not so easy when the liquid is cold.

After the precipitate had been allowed to stand for some time, the clear liquid above it was decanted into a filter. The precipitate was then washed with cold water, first by decantation in the beaker and afterwards upon the filter. The filtrate proper, that is to say, the clear liquor decanted from the precipitate, was in every instance colourless. It gave a white residue when evaporated on platinum foil and no precipitate when tested with acetate of lead. But all the subsequent liquors obtained by decantation and washing came through the filter distinctly yellow-coloured. They gave yellow residues when evaporated upon foil and bright yellow precipitates when tested with acetate of lead. It was, consequently, no easy matter to determine when to stop washing. The precipitates were, in fact, put aside to dry as soon as there was any reason to suppose that the saline mother-liquor had all been washed out from them.

In the second of the following experiments the chromate of barium was weighed upon a tared filter, as was the case also in the experiments cited above, but in Nos. 1, 3, and 4, the dry precipitate was ignited gently in a porcelain crucible before weighing.

No. of the experiment.	Grms. of $KO,_2CrO_3$ taken.	Grms. of BaO,CrO_3 found.	Percentage of chromium found.	Theory.
1.	1·0095	1·7301	35·47	35·56
2.	1·0175	1·8444	37·53	
3.	1·5456	2·7541	37·74	
4.	1·5020	2·5696	35·49	

Experiments 3 and 4 were carried out side by side, and every effort made to treat them exactly alike.

From the appearance and behaviour of the wash-water, as above described, it appears that chromate of barium is somewhat soluble in pure water, but is insoluble in tolerably strong saline solutions, even in the presence of acetic acid. This observation agrees in the main with a statement * in Professor Storer's "Dictionary of Solubilities" to the effect that "chromate of baryta is very slightly soluble in water, and even insoluble when other salts are present in solution."

* Cited from Dumas's Traité de Chemie appliquée aux Arts.

On the other hand, the excess of precipitate found in experiments 2 and 3, would go to show that chloride of barium is liable to be dragged down by chromate of barium in the same way that it is apt to go down with sulphate of barium. It would appear, therefore, that some saline solution, competent to dissolve chloride and nitrate of barium, should be used instead of water for washing chromate of barium. [P.S.—In accordance with this view Mr. A. H. Pearson has recently employed a solution of acetate of ammonium, with the best results, for washing both the chromate and the sulphate of barium.]—*American Journal of Science*, vol. xlviii., No. 143.

REPORTS OF SOCIETIES.

GLASGOW PHILOSOPHICAL SOCIETY.

(Chemical Section.)

Ordinary Meeting, March 14, 1870.

Mr. Alexander Whitelaw, *Vice-President, in the Chair.*

Mr. W. R. Hutton read a paper on "*Canadian Phosphate of Lime, and some other Mineral Phosphates now Used in Making Superphosphate of Lime.*" The author mentioned that many mineral compounds having different characteristics both in physical appearance and in chemical compounds, as well as in results when operated upon, are now used in the manufacture of artificial manures, and referred to the fact that agriculturists are annually making greater demands upon the manufacturers of superphosphate of lime. He stated that, in general terms, the value of a mineral phosphate depends upon the percentage of phosphoric acid contained in it, but if there is any marked quantity of carbonate of lime present, the value of the phosphoric acid is much reduced, owing chiefly to the large quantity of sulphuric acid required to decompose the carbonate of lime before the phosphate can be reduced. The same remark holds true with reference to phosphatic minerals containing iron compounds in combination; the iron takes up its own equivalent of sulphuric acid, and as it is peroxidised a compound is formed which is positively injurious to plant life. Fluoride of calcium is also invariably found in phosphatic minerals, and it, too, requires sulphuric acid, thus increasing the cost of the superphosphate formed, while the gaseous fluorine compounds set free are a source of annoyance. No mineral phosphate has been so extensively employed as coprolites, and none is so little understood and valued by agriculturists. Although agriculturists, and even some manufacturers of manures, are inclined to look suspiciously upon the superphosphate of lime made from coprolites, Mr. Hutton said that his experience went to prove that superphosphate of lime is always of the same chemical value as a manurial agent, no matter what source it is obtained from. After referring to the origin and nature of coprolites, and the extent of the deposits in Cambridgeshire, Bedfordshire, and Suffolk, from which upwards of 200,000 tons are annually raised, the author proceeded to speak of the necessity for additional sources of mineral phosphates being resorted to, and new deposits being brought within the reach of manufacturers of manures, even if brought from other countries. He spoke of the German and Spanish phosphates as being very extensively had recourse to, although not so valuable as the English coprolites. Reference was made to a large and valuable deposit which occurs in South Carolina, and which has recently been brought into notice. Mr. Hutton mentioned that he was supplied some months since with specimens of phosphate of lime from Canada, obtained from a face of the material nearly fifteen feet in width, and presenting, so far as yet examined, an excellent supply of the raw material. The samples differ very much from those phosphatic minerals which are now in use, and seem to indicate that if a sufficiency can be obtained the Canadian mineral will be welcomed by manure manufacturers. Some of the specimens sent were distinct six-sided prismatic crystals, while the other pieces were in masses; but both crystals and masses had a vitreous lustre, the colour on some parts being green and bluish-green, and in other places red. The following analyses were given:—

	Masses.	Crystals.
Phosphate of lime	86·61	90·82
Fluoride of calcium	7·22	5·70
Chloride of calcium	0·06	0·14
Carbonate of lime	4·47	0·38
Moisture	0·08	0·32
Sand	0·10	0·10
	98·54	97·46
Oxide of iron		0·40
		97·86
Specific gravity	3·142	3·166

In a physical point of view this Canadian phosphate differs from all others in being crystalline and not granular; while it differs chemically in containing more phosphate of lime and less carbonate of lime and sand.

A short discussion followed the reading of the paper.

Mr. James Mahony afterwards read a paper entitled "*A Note on Plate Sulphate of Potash.*" This compound is obtained as a product from kelp, either by direct crystallisation from the lyes, or by solution and crystallisation of the granulate sulphate which is precipitated in the process of boiling down the liquors. When the liquor is about 42 to 44 of Twaddell, it is run into coolers, and in a day or two crystals are formed. The liquor is again saturated with soft sulphate, and a second crop of crystals is obtained on the first, and so on till a cake of sufficient thickness is produced. This salt is really a double sulphate, a fact first noticed by the late Dr. Penny; but the author of the paper finds that in practice the salt never contains more than from 73 to 75 per cent of the potassic sulphate instead of 78·56, as would be the case if the salts were present in the proportion of three of potassic to one of sodic sulphate. The plates enclose, during the time of their formation, small portions of the mother liquor which, becoming crystallised, account for the presence of chlorides and other salts, and thus diminish the percentage of potash. The well-defined crystals on the surface of the plates are almost pure. One of them examined by the author gave 77·60 per cent of sulphate of potash. Being clearly a double salt, the author said it might be expected that its solution and re-crystallisation would only have the effect of yielding a purer and more typical double sulphate. But this is not the case, for its component salts then become separated from each other in the order of their respective solubilities. Mr. Mahony proved this by operating upon five pounds of ordinary plate sulphate of potash, roughly pounding and dissolving in a sufficiency of boiling water. The insoluble matter was allowed to settle and was separated by a calico filter. The whole of the solution at 25° of Twaddell, was boiled down to 38°, when a pellicle formed on the surface. On analysis the first crystals gave—

$KOSO_3$	86·23
$NaOSO_3$	13·83
	100·06

There was not a trace of chlorine. The salt deposited at the bottom gave—

$KOSO_3$	84·26
$NaOSO_3$	15·66
	99·92

The pellicle of crystals on the surface gave $KOSO_3$ 81·16.

After removal of the first crop the mother-liquor was again boiled down to 38° Twaddell, and a second crop of crystals similar in appearance to the first gave—

Crystals	82·09	$KOSO_3$
Bottom	77·65	"

The operation of boiling down and crystallising was performed six times. In the fifth crop there was a layer of sulphate of potash with large, well-defined crystals of sulphate of soda on the top; and the sixth crop was chiefly sulphate of soda. The total quantity of salt removed was 4 lbs. 13 ozs., containing 3 lbs. 10·36 ozs. of pure sulphate of potash, the insoluble and loss amounting to 3 ozs. Sulphate of soda, being the more soluble salt of the two, was thus shown to remain in the liquor to the last, and, therefore, plate sulphate of potash cannot be classed in the category of ordinary double salts which remain of similar composition on re-crystallisation. In conclusion, the author referred at some length to the phenomenon of phosphorescence observed in the course of the process of crystallisation. He said it was affected by climatal influences, being more brilliant on some nights than others, and thus it might be assumed to be due to the electrical condition of the atmosphere.

A short discussion followed, in the course of which it was suggested that as Mr. Mahony was as accomplished as a naturalist as he was skilled as a chemist, he should give the section a paper on the phenomenon of phosphorescence as illustrated both by crystallising minerals and by the sea.

Votes of thanks were awarded to the authors of both papers.

Ordinary Meeting, March 28th, 1870.

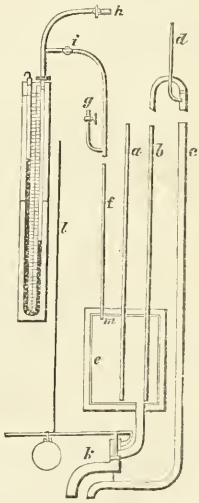
Mr. E. C. C. Stanford, F.C.S., Vice-President, in the Chair.

Mr. T. L. Patterson read two papers. The first was entitled—"*On a Method for Obtaining a Continuous Current of Air or Gas under Pressure, for Blowpipe and other purposes.*"

The author first explained how a continuous current of air or gas is obtained under ordinary circumstances, by the mouth blowpipe or the foot-bellows, and then mentioned the chief objections to those two methods, and proceeded to describe a method which he had found to be free from those objections. He said that it was well adapted to blowpipe work, and that he could easily obtain a pressure equal to half an atmosphere by means of it. The principle involved is the same as the Catalan blowpipe of Sprengel, and is wrought in connection with a Bunsen filter-pump, although it may be erected separately. The air-tap of a Bunsen pump being opened, the water is turned on, and air passes with the water down a long pipe, of 30 to 35 feet, in a continuous stream of bubbles. By receiving the stream into a bottle or other vessel, made air-tight with a cork through which two tubes are passed, one nearly to the bottom of the vessel and the other just through the cork, the water will flow off by the deep tube, and air escape by the upper; and, by placing a stopcock on the upper tube, to regulate the escape of the air, the pressure in the vessel may be made equal to the height of the water-tube. The apparatus, as used by Mr. Patterson, is made of sheet-lead and "compo" pipes. Its arrangement is shown in the accompanying sketch. The internal diameter of the water-pipes is ½ inch, and of the air-pipes ¼ inch.

At *a* is shown the exhaust-pipe of the pump; it reaches to within ⅜ of an inch of the bottom of the leaden vessel, *e*, which is 9 inches square and 1 foot high. This vessel, or *accumulator*, is enclosed in a wooden box, by which its sides are supported. Two holes are pierced through the top, at opposite corners, and through one the water-pipe, *b*, passes to within ⅜ of an inch of the bottom, and made air-tight. It is carried up alongside of the exhaust-pipe as high as is necessary for the desired pressure, and then bent back, and soldered into a 1-inch pipe, *c*, which returns, and carries the overflow-water from the pressure-pipe, *b*, to the sewer. At *d* is shown a short piece of ¼-inch pipe, fixed into the waste-pipe, *c*, so that the latter may not act as a syphon. Into the other hole in the leaden vessel, *e*, a piece of ¼-inch pipe, *f*, long enough to reach to the laboratory, is soldered air-tight. One or more communications, as at *g*, may be taken off the pipe *f* to convenient places in the laboratory, and the pipe itself is continued to the same manometer as is used to show the vacuum obtained by the pump. Just before the vacuum and pressure pipes unite, however, there is a cock soldered into each, so that, when the pump is working, the vacuum-cock, *h*, is open and the pressure-cock, *i*, is shut—the reverse being the case when the pressure apparatus is required. The mercury in the manometer gives the vacuum or pressure in m.m.

Beneath the vessel, *e*, is placed a lever stopcock, *k*, of 1 inch diameter, to give free exit to the water while the pump is working for a full vacuum. This cock is wrought by means of wires, *l*, and pulleys, and thus, when the water is in the laboratory, the whole apparatus is under the operator's control. The mode of operating is as follows:—The lever-cock below the accumulator is opened, the vacuum and pressure cocks adjusted, and the water is turned on; and then the mercury in the near limb of the U-tube rises, and indicates a vacuum. But, when pressure is wanted (as for a blowpipe), the lever-cock is closed, the air-pipe of the



pump gently opened, the manometer gently adjusted, and, when the mercury is at the greatest height, the air is turned on to the blowpipe by the stopcock, *g*, and then the flame will continue regular, and as long as water and air flow down the exhaust-tube. The adjustment for the flow of water is the same for the pressure as for the vacuum apparatus.

This arrangement is suitable for conducting experiments under pressure, when that is not to be greater than half an atmosphere or so. In Mr. Patterson's apparatus, the pipe only rises to a height of 13½ feet, equal to a column of mercury 303·6 m.m., or 11·95 inches. The author had no doubt that the apparatus would work well up to nearly half an atmosphere, and probably more, if the tubes could be indefinitely lengthened, as the quantity of air delivered by the sp-

paratus in a given time varies with the difference between the lengths of the exhaust and pressure pipes. A liquid may be boiled under the constant pressure of the apparatus by placing it in a strong flask, and connecting the latter (air-tight), by means of a flexible tube, with the pressure stopcock; or it may be distilled by connecting the receiver (made air-tight to the retort or distilling-vessel) with the pressure stopcock, as before. It will also be found useful for increasing filtration, by applying the pressure on the surface of the liquid to be filtered, when it is not desirable to use, or convenient to obtain, suction from beneath. Probably the most useful application of this air-current is to the blowpipe. With a Herapath lamp, it is easy, by means of the stopcocks, to obtain a small oxidising or reducing flame suitable for chemical experiments, or the strong and powerful jet for glass-blowing and crucible operations.

The author had not tried the apparatus with a Griffin's blast gas-burner; but, from calculations made, he had no doubt that, with a Herapath lamp, he could get a blast quite as strong as that obtained by using the Griffin lamp. He stated that it would be desirable to have a float-valve at the mouth of the air-pipe, *m*, in the accumulator, to prevent the access of water into it, in the event of the apparatus at any time becoming deranged or overtaxed. In conclusion, the author explained how the apparatus might be used for delivering a steady current of any other gas not very soluble in water.

The cost of Mr. Patterson's apparatus, as fitted in connection with a Bunsen pump, is about 30s.

A discussion followed. Several members expressed themselves much interested in, and pleased with, the apparatus, as described by Mr. Patterson.

The other paper read by Mr. Patterson was, "*On an Explosive Balloon.*"

The author gave an account of some efforts which he made some years ago to fire explosive balloons on their ascent. At first he tried the india-rubber balloons of the toy-shops. From various causes, they had failed; but the chief difficulty was doubtless the tension, which made it difficult to secure the gases. Recently the author's attention had been directed to the collodion balloons, obtainable of the philosophical-instrument makers, believing that they would suit well, both on account of their lightness, and on account of the fact that they would wholly disappear on ignition. After a number of trials, he had found them to succeed admirably. The method adopted was as follows:—A fuse of filter-paper, about 1 inch long and ½ an inch broad, is gummed to the side of the balloon, near the mouth, and allowed to dry. The latter is then filled with a mixture of 2½ volumes of hydrogen gas and 1 volume of oxygen, the mixture being prepared in a separate vessel. The mouth of the balloon is at once tied with a piece of thread, to increase the force of the explosion. When the balloon is ready to ascend, a drop of the so-called "Greek fire" (that is, a solution of phosphorus in carbon disulphide) is placed upon the filter-paper; the thread is cut, and the balloon left to itself. In the course of half a minute or so, the explosion ensues. It is necessary to have an excess of hydrogen in the mixture, because exosmose takes place so rapidly that, by the time of ignition, the volume of that gas is sensibly reduced.

The author mentioned that, in the course of his experiments with collodion balloons, he had found a very sensible amount of heat generated in the collodion film. This he believed to be due to the oxidation of hydrogen in the pores of the collodion, somewhat similar to the action of spongy platinum or platinum-black on a mixture of the two gases.

CHEMICAL SOCIETY.

Anniversary Meeting, March 30th, 1870.

Dr. A. W. Williamson, F.R.S., &c., *President, in the Chair.* The following Officers have been elected for the ensuing year:—

President—A. W. Williamson, Ph.D., F.R.S.

Vice-Presidents who have filled the office of President—Sir B. C. Brodie, F.R.S.; Warren De la Rue, Ph.D., F.R.S.; A. W. Hofmann, D.C.L., F.R.S.; W. A. Miller, M.D., D.C.L., F.R.S.; Lyon Playfair, Ph.D., C.B., F.R.S.; Col. P. Yorke, F.R.S.

Vice-Presidents—J. H. Gilbert, Ph.D., F.R.S.; E. Frankland, Ph.D., F.R.S.; A. Mattheissen, Ph.D., F.R.S.; H. M. Noad, Ph.D., F.R.S.; W. Odling, M.B., F.R.S.; T. Redwood, Ph.D.

Secretaries—A. Vernon Harcourt, M.A., F.R.S.; W. H. Perkin, F.R.S.

Foreign Secretary—H. Müller, Ph.D., F.R.S.

Treasurer—F. A. Abel, F.R.S.

Ordinary Members of the Council—E. Atkinson, Ph.D.; H. Bassett; E. T. Chapman; F. Field, F.R.S.; David Forbes, F.R.S.; M. Holzmann, Ph.D.; E. J. Mills, D.Sc.; W. J. Russell, Ph.D.; Maxwell Simpson, Ph.D., F.R.S.; R. Angus Smith, Ph.D., F.R.S.; John Tyndall, LL.D., F.R.S.; A. Voelcker, Ph.D.

After having communicated to the Fellows the above list, the President delivered the following address:—

Gentlemen,—On behalf of the Council, I feel very great pleasure in congratulating you on the rapidly-increasing usefulness and prosperity of our Society.

The most interesting incident in the history of the past year has been the delivery by M. Dumas of the Inaugural Faraday lecture. It was indeed an impressive tribute to the memory of our great countryman which was paid by that noble veteran of science, and one of which the record ought to occupy a place of honour in our Journal. We still hope to receive from M. Dumas a manuscript of his classical discourse.

The Council have had the pleasure of accepting the offer of a munificent donation of palladium from Messrs. Johnson and Matthey, to be used for the preparation of the first ten Faraday medals.

Your Council have felt it to be of considerable importance to give greater publicity to the proceedings of the Society, and they have accordingly made provisional arrangements for the preparation of abstracts of the papers, and, in some cases, of the discussions, for transmission to such papers as desire to publish them. These abstracts already appear in several papers, and are read with interest

At the time of the last Anniversary Meeting, the Society numbered 522 Fellows. Since that time, 41 new Fellows have been elected, and have paid their admission-fees. On the other hand, six Fellows have been removed for non-payment of fees, one Member (Mr. A. W. Gillman) has withdrawn from the Society, and we have lost five by death. The present number of Fellows is accordingly 551.

The number of Foreign Members at the time of our last Anniversary Meeting was thirty-eight, but of these we have to deplore the death of two, viz, Dr. Otto Linné Erdmann, Leipzig, and Dr. Joseph Redtenbacher, Vienna; so that we now count only thirty-six Foreign Members.

The names of the Fellows who have died during the past year are:—Thomas Graham, Sept. 16th; T. Penny, Nov. 22nd; A. B. Northcote, Dec. 28th; E. N. Brayley, Feb.; and I have this morning received intelligence of the death of Julian Courtauld and T. L. Wheeler.

Thomas Graham died September 16th, at his house, 4, Gordon Square.

From an early age, Graham's one great object of life was the discovery of new truths, and he appreciated so fully the value of such work that he resolved to make any personal sacrifices which might be needed for its sake. And nobly he kept his resolution; for, at an early stage of his career, he endured, for the sake of pursuing chemistry, privations and sufferings so severe that they are believed to have permanently injured his constitution; and, at its very end, long after he had attained a world-wide reputation, when his delicate frame sorely needed the repose which was at his command, he continued to labour even more effectively than before, and to enrich science with new discoveries.

It might be difficult to find in history a character so perfect in its noble simplicity and elevation.

Graham was born at Glasgow, on December 21st, 1805, the eldest of a family of seven, of whom only one survives.

He went to the English Preparatory School at Glasgow in 1811, and was there under the care of Dr. Angus. In the year 1814, he was removed to the High School, where, for four years, his studies (which included the Latin language) were directed by Dr. Dymock, and subsequently for one year by the Rector, Dr. Chrystal, under whom he studied Greek. It is said that during these five years he was not once absent at school-time In 1819, he commenced attendance in the University classes in Glasgow.

Thomas Thomson then occupied the Chair of Chemistry, and young Graham benefited by his instruction, as, also, by that of Dr. Meikleham, the Professor of Natural Philosophy.

By this time he had already acquired a strong taste for experimental science, and formed a wish to devote himself to chemistry. His father, an able and successful manufacturer, had formed different views for his future career, and wished him to become a minister of the Scotch Church. It is hardly to be wondered at that the father should not have seen in the prosecution of science much scope for an honourable or advantageous career; but young Graham had already seen something of the means afforded by experimental science of getting knowledge from the fountain-head—from Nature herself. He felt the need of more such knowledge to mankind, and his scheme of life was formed accordingly.

After taking the degree of M.A. at Glasgow, he continued his studies for two years at Edinburgh, and there studied under Dr. Hope, and enjoyed the friendship of Professor Leslie. On his return to Glasgow, he taught mathematics for some time, at the suggestion and under the patronage of Dr. Meikleham, and subsequently opened a laboratory, in Portland Street, Glasgow, where he taught chemistry. It is probable that some of the severest trials of his life occurred at about this period.

While absent from Glasgow, he was in the habit of writing regularly and at great length to his mother; and from the tenour of these letters, it is easy to see what that mother must have been to him. A writer on the social position of women has described the feelings of boys towards their mothers as scarcely amounting to respect! Young Graham's mother seems to have been his guardian-angel, sympathising with his hopes and his sorrows; and certainly his feelings towards her would have been very inadequately described by that frigid word. While studying at Edinburgh, he earned, for the first time in his life, some money, by literary work, and the whole sum (£6) was expended in presents to his mother and sisters.

In 1829, he was appointed Lecturer on Chemistry at the Mechanics' Institution, Glasgow, in place of Dr. Clarke; but the decisive step of his life was in the subsequent year. It was in 1830 that he was appointed Professor of Chemistry at the Andersonian University, Glasgow; and it is said that his mother, who was on her deathbed, lived to hear the glad tidings of his appointment. He was now more favourably circumstanced for experimental labours; and we find that the seven years spent at the Andersonian University were years of great activity.

In the beginning of the year 1837 died Edward Turner, Professor of Chemistry in the newly-founded London University, now called University College, London. Thomas Graham was the successful candidate for the vacant chair, and in August of the same year we find him already settled in the great metropolis. It was only now that the young philosopher found adequate scope for his abilities. Young men thirsting for knowledge crowded to his lectures, and in those lectures he explained the principles of chemical science with an exactness and clearness never before attained. The success of these lectures was not due to eloquence, nor to any smoothness of diction, for all such matters Graham usually neglected to a degree which in an ordinary person would hardly have been excused. He had a truly philosophical method, which carried away the listener with irresistible force,—the same exactness of thought, the same logical arrangement of matter—in a word, the same purely scientific mind which pervades his work, "The Elements of Chemistry." That work, which immediately made its author's name known in all parts of the world, is too well known to the Fellows of the Chemical Society for it to be necessary to speak here of its great merits. I will merely allude to the successive editions which have appeared in England, the numerous reprints scattered about America, and the translations published in many languages. In Germany, the excellent edition of Fr. Tul. Otto is still the most extensively used and the most valued book of chemical instruction.

Of Graham's investigations that on the phosphates is remarkable in many ways. It was known that solutions of phosphoric acid in water vary in their properties; and chemists were satisfied with giving a name to the changes without investigating their nature. These solutions contained phosphoric acid and water, and were assumed to have like composition. They were accordingly called isomeric. Graham observed that they differ from one another in the proportion of water combined with the acid, and constitute in reality different compounds.

He knew that water combines with acids as other bases do, and he showed that the various compounds of phosphoric acid and water constitute distinct salts, each of which admits of its hydrogen being replaced by other metals without disturbance of what we should now call the type. Thus, to use our present notation, the three hydrates PO_4H_3, $P_2O_7H_4$, PO_3H, correspond to the following proportions of acid and water:—

$$P_2O_5+3H_2O=2PO_4H_3$$
$$P_2O_5+2H_2O=P_2O_7H_4$$
$$P_2O_5+\ H_2O=2PO_3H$$

Graham observed that the hydrate PO_4H_3 is constituted like a salt, inasmuch as its hydrogen can be replaced, atom for atom, by other metals, like sodium, potassium, &c., forming such compounds as PO_4NaH_2, PO_4Na_2H, &c.

In order to appreciate duly the powers of mind of the author of this admirable research, we ought to compare his methods of reasoning with those generally prevalent among contemporary chemists, and, on the other hand, with the methods of to-day. One would fancy that Graham had been acquainted with the modern doctrines of types and of polybasic acids, so clearly does he describe the chemical changes in matter-of-fact language, and so consistently does he classify the compounds by their analogies. At that early period we find Graham considering hydrogen, in various salts, as a basylous metal; an idea which, in spite of its undeniable truth, some chemists of the present day have not fully realised.

Amongst minor chemical researches, may be mentioned a series of experiments on the slow oxidation of phosphorus by atmospheric air. He discovered that this process (and the faint light which accompanies it) is arrested by the presence in the air of a trace of olefiant gas, 1-450th of the volume of the air being sufficient for the purpose. Still smaller proportions of some other vapours were found capable of producing this same effect; spirits of turpentine being particularly remarkable, as less than a quarter of a thousandth of its vapour with air was found sufficient to prevent the slow oxidation of phosphorus.

On another occasion Graham investigated phosphuretted hydrogen, and made some remarkable observations concerning the conditions of the formation of the spontaneously inflammable gas. One of these deserves especial notice in connection with the action of olefiant gas, and in preventing the oxidation of phosphorus. He found that phosphuretted hydrogen is rendered spontaneously inflammable by the admixture of a very small proportion of an oxide of nitrogen, probably nitrous acid.

One of the most obscure classes of combinations are those which water forms with various salts. These bodies are characterised by the chief peculiarities which belong to definite chemical compounds; but chemists are, as yet, unable to explain them.

Water so combined is called water of crystallisation, and is said to be physically, not chemically, combined. A very convenient way of getting rid of a difficulty, by passing it on to our neighbours.

Graham examined the proportion of such water of crystallisation in a considerable number of salts, and he moreover examined the properties which it has when so combined. He found that some of the water in an important class of sulphates is held far more firmly than the remainder, and with force equal to that with which water is held in various chemical compounds. He showed that such firmly combined water can be replaced by salts in a definite chemical proportion. In fact, he got fairly hold of the subject by chemical methods, and laid the foundation for an explanation of it.

He discovered and examined compounds of alcohol with salts, and derived from them valuable evidence of the analogy between alcohol and water.

On a later occasion he made a series of important experiments upon the transformation of alcohol into ether and water, by the action of hydric sulphate. Liebig had endeavoured to explain the formation of ether in this process, by representing it as due to the decomposition at a high temperature of a compound of ether previously formed at a lower temperature; such decomposition being due to the increased tension of the vapour of ether at the higher temperature.

Graham justly argued that if the decomposition were due to the tension of ether vapour, it would not take place, and ether would not be formed, if the tension were not allowed to exert itself. He heated the materials in a closed tube, and proved that ether was formed, although the tension of its vapour was counteracted by the pressure thus obtained.

The line of research which occupied most of his attention, and in which his results were, perhaps, the most important, was that of diffusion; and it would be difficult to over-estimate the importance to molecular chemistry of his measurements of the relative velocities of these spontaneous motions of particles of matter, whether in the state of gas or in the liquid state.

It was known that one part by weight of hydrogen occupies the same volume as sixteen parts by weight of oxygen when measured at like temperature and under like pressure. Chemical investigations prove that these equal volumes of the two gases contain the same number of atoms. We also know that the atoms in such a gas are in rapid motion, and resist the pressure to which the gas is at any particular time exposed, by striking against the surface which presses them together with force equal to that which presses them together.

Thus a given volume of hydrogen is maintained against the atmospheric pressure by an energy of atomic motion, equal to that of the same volume of oxygen. Each atom of hydrogen accordingly exerts a mechanical energy equal to that of each atom of oxygen; but we have seen that the hydrogen atom is much lighter than the oxygen atom, and accordingly it must move with much greater velocity than the oxygen atom.

Now Graham allowed hydrogen to escape through a very small hole in a plate of platinum; and allowed oxygen to escape under similar circumstances. He found that each hydrogen atom moves out four times as fast as each oxygen atom. His experiments were so arranged as to enable him to measure the relative velocities of certain motions of the atoms—motions not imparted to them by any peculiar or unnatural conditions, but belonging to them of necessity in their natural state. He found, moreover, that heat increases the velocity of these atomic motions, whilst increasing the force with which a given weight of the gas resists the atmospheric pressure.

He remained at University College till the year 1855, when he was appointed Master of the Mint, an office which Sir John Herschel had recently resigned. His illustrious friend, Hofmann, from whom I have already freely quoted, shall tell how he discharged these responsible duties.

"It would be difficult to picture the extensive activity which Graham exercised in the high office entrusted to him. The new Master of the Mint showed a circumspection, a mastery of details, an amount of industry and energy, and when occasion required an impartial severity, which astonished every one—more especially some of the officials of the Mint. Such requirements had not hitherto been made, nor such control exercised. A strong resistance was made to the plans of innovation and alteration of the new Master." The author of these lines, Hofmann, at that time held an office in connection with the Mint, and was, therefore, witness of Graham's struggles in his new position. "It was years before he gained a complete victory, and before he was able to return to his favourite study. But at last this longed for period came, and a series of happy years followed. Not an instant was lost. A convenient laboratory was fitted up in the official residence of the Master of the Mint, whose handsome rooms the simple and independent man never occupied, and there his old labours were resumed with greater zeal than ever. Some of Graham's most beautiful researches date from this period. They sprang from the pure love of science. Graham needed to earn no name or position. Both had long been his undisputed property. But the same earnest desire to study nature which in early youth had induced him to bear without murmurs the greatest privations and the bitterest sorrows, still animated him and armed him against the new dangers which threatened his scientific labours from the splendour of his official position and the distractions which it entailed on him."

The study of the condensation of gases by solids, and the combination of soluble compounds with membranes, led him to discoveries which are likely to be of great value to physiologists in explaining processes of absorption and secretion.

Thus he found that oxygen is absorbed to a greater extent than nitrogen by caoutchouc, and that when a bag made of a thin membrane of this substance is exhausted by means of a good air-pump, the oxygen and nitrogen diffuse through it (probably as condensed liquids), and evaporate inside the bag in different proportions from those in which they are present in air; the oxygen rising to over 40 per cent of the diffused air. Again, a mixture of hydrogen and oxygen was separated almost completely by the action of palladium, which condensed the hydrogen in very large quantity, and the oxygen very slightly.

Perhaps the most remarkable substances discovered in the course of his experiments on diffusion were the soluble modifications of tungstic and molybdic acids, ferric oxide, &c., and the process by which these bodies were obtained was, perhaps, the most instructive part of the result; proving, as it does, that in their salts, these bodies have properties different from those which they normally possess in the free state; and retain them when the other constituent is removed by a sufficiently gentle process.

Another remarkable fact which bears on a most important theory, is the separation effected by Graham of potassic hydrate and hydric sulphate, by diffusion of potassic sulphate in aqueous solution—a fact which requires us to admit that the solution of the salt in water contains those products mixed with one another; just as much as the experiment of diffusing air through a porous clay pipe, and getting its constituent in a different proportion from that of the original air, proved that air is a mixture and not a compound of the two gases.

The phenomena of the diffusion of gases and liquids do not astonish us by their brilliancy and variety; but the im-

mense importance of this region of experimental science dawns upon us when we remember that there is no so-called vital process which cannot ultimately be referred to a chemical process, that more or less intense chemical action takes place at all points of the frame of animals and plants, and that an essential condition of this action, and of life itself, is the carrying to and fro of materials, not only by muscular and ciliary action, but in a more intimate measure by diffusion.

In many of his ideas Graham was in advance of his contemporaries, and it might be difficult to find a chemist who has dealt more cautiously with general questions and delicate experimental operations,—or one whose results, in each direction in which he has worked, may more safely be expected to stand the test of future investigations.

The proceedings of the meeting terminated with a vote of thanks to the President for the able and effective manner in which he had discharged his official duties during the past year.

April 7th, 1870.

Professor WILLIAMSON, F.R.S., President, in the Chair.

THE following gentlemen were elected Fellows:—F. Andrews, jun., W. Martindale, A. H. Palmer.

Dr. DIVERS concluded his paper "*On the Combinations of Carbonic Acid with Ammonia and Water.*"

This elaborate and very extensive memoir does not permit of any abbreviation. Readers desiring more information are therefore referred to the *Journal of the Chemical Society*, which will, in one of the next numbers, publish Dr. Divers's investigations.

Dr. GLADSTONE communicated a paper "*On the Refraction Equivalents of the Aromatic Hydrocarbons, and their Derivatives.*"

In a previous paper (read before the Society on March 3rd), it was shown that, having ascertained the refraction equivalents of carbon, hydrogen, oxygen, nitrogen, and chlorine, the refractive values of a large number of compounds, built up by those elements, may be calculated with a close approximation to the truth. In the present paper, Dr. Gladstone treats with the exceptions to that rule. Phenylic acid, oil of bitter almonds, salicylic acid, methylic salicylate, methylic benzoate, ethylic benzoate, benzol, toluol, xylol, cumol, cymol, carvol, eugenic acid, pyridine, chinoline, aniline, nitrobenzol, chlorobenzol, naphthalin, and many others yet, give, by experiment, much higher refractive values than by calculation. A glance at the names of these exceptional substances will show that they consist of the aromatic hydrocarbons, with the bodies derived from, or related to, them. The refraction equivalents of the hydrocarbons themselves, and their chlorine substitution products, are about 6·0 above what theory requires; the compounds from creosote are a little higher still. The azotised products, and those containing C_7, are very nearly 8·0 above the calculated values, and hydride of cynnamyl is well known to be among the most refractive and dispersive of bodies. To what can this increased refraction be attributed? Dr. Gladstone thought first that the hydrogen in benzol and its congeners or derivatives might have a refraction value of 3·5 as in the hydracids of the halogens. But on investigating chlorhydranil, $C_6Cl_4O_2H_2$, where the greater part of the hydrogen is replaced by chlorine, and where the existing hydrogen is considered not to belong to the nucleus, a refraction equivalent of 7·6, that is, about the usual amount above the theoretical value, was obtained. Dr. Gladstone is now disposed to regard the nucleus, phenyl, C_6H_5, as an entity, having an exceptionally great influence on the rays of light, and this augmentation of refractive power has its analogy to that change in the refraction value which certain elements (for instance, iron and phosphorus), undergo when they alter their atomicity. This entity is not destroyed by the replacement of its hydrogen by chlorine, nitric oxide, oxygen, or sulphur. When, however, this nucleus is subjected to such chemical change as to break it up, the resulting products have only the ordinary effect on light.

Taking the difference of the figures obtained by experiment, and of those by calculation, it is found that the group of essential oils give refractive values of about 2 higher than required by theory; the phenyl group about 6 above the theory; the naphthalin group about 14; and the anthracen group about 17 above the calculated figures. Now, in these groups, the carbon increases in proportion to the hydrogen, and thus it becomes probable to arrange the above substances into certain series, which Dr. Gladstone regards, however, as merely a rough sketch, and by no means as a decided question. He hopes, at some future time, to say more on this subject.

Mr. HUNTER, of Queen's College, Belfast, communicated a paper on "*Analysis of Deep Sea Water*," a sequel to a note read before the Society in December last.

Messrs. BOLAS and GLOVES read a note "*On the Convenient Preparation of Bromo-picrin.*" They also gave preliminary announcement of the discovery of tetra-bromide of carbon.

Professor HOW had sent a memoir "*On on Acid Feed Water from the Coal-Field at Stellarton, Nova Scotia.*" The paper is chiefly remarkable by giving information of the presence of free oil of vitriol in the water which is used for feeding boilers.

For the meeting on April 21st, a lecture "*On Vanadium*," by Professor ROSCOE, is announced.

April 21st, 1870.

Professor WILLIAMSON, F.R.S., President, in the Chair.

T. PATCHETT was elected a Fellow.

Professor ROSCOE, F.R.S., delivered a lecture "*On Vanadium.*"

This metal was discovered in 1830, by Sefström, in the celebrated Swedish bar-iron made from the Taberg ore. Sefström ascertained some of the most peculiar characters of this substance, proved it to be a new element, and prepared some of its compounds in the pure state. The reactions by which vanadium can be separated and distinguished from all the other elements are:—(1) The formation of a soluble sodium vanadate when the vanadium compounds are fused with sodium carbonate; (2) the formation of an insoluble ammonium vanadate when sal ammoniac is added to the solution of a soluble vanadate; (3) the production of a splendid blue solution when this ammonium salt, dissolved in hydrochloric acid, is warmed with reducing agents, such as oxalic acid.

Sefström, not having leisure to prosecute the full examination of the properties of the new metal, handed over his preparations to Berzelius; and it is to the investigations of the great Swede that we owe almost all our acquaintance with the chemistry of vanadium.

Since Berzelius's time, vanadium has been discovered in many minerals, of which a lead ore containing lead vanadate, and called by the mineralogists, vanadinite, is the most important.

In 1865, Professor Roscoe came into possession of a plentiful source of vanadium, in a by-product obtained in the preparation of cobalt from the copper-bearing beds of the lower Keuper Sandstone of the Trias, at Alderley Edge, in Cheshire. Following, in the main, the process of preparation adopted by Sefström, Professor Roscoe obtained, from the above-mentioned source, several pounds of pure ammonium vanadate, from which all the other compounds of vanadium can be prepared.

What, now, were the conclusions to which Berzelius arrived, from his experiments concerning the constitution of the vanadium compounds? He assigned to its three oxides the formulæ VO, VO_2, and VO_3, whilst the chloride was represented by VCl_2. The atomic weight of the metal he found to be V=68·5.

Some years afterwards, Rammelsberg observed that vanadinite, a double salt of lead-vanadate and lead chloride, is isomorphous with apatite and with mimitesite, the former containing phosphoric, the latter arsenic acid. This crystallographic analogy would lead us to conclude that the oxide of vanadium in the vanadinite has the formula V_2O_5, agreeing with the corresponding oxides of phosphorus and arsenic, P_2O_5 and As_2O_5; but the unyielding chemical facts of Berzelius compel us to view the oxide in question as VO_2. It was, then, evident that here was either an exception to the law of isomorphism, or else Berzelius's views were erroneous.

Professor Roscoe, in order to endeavour to clear up this question, had carefully repeated Berzelius's experiments, and he found them confirmed in every particular; but, having pursued the subject further than Berzelius, he had succeeded in obtaining the key to the enigma presented by the above anomalous crystallographic relations.

The lecturer has proved that the substance supposed by Berzelius to be vanadium is not the metal, but an oxide, and that the true atomic weight of the metal is 51·3. The vanadic acid, VO_2, of Berzelius, hence, becomes V_2O_5, corresponding to P_2O_5 and As_2O_5; and the above-mentioned isomorphism is fully explained. The sub-oxide of Berzelius is a tri-oxide, V_2O_3; whilst the terchloride (VCl_3) of Berzelius is an oxychloride, $VOCl_3$, corresponding to oxychloride of phosphorus, $POCl_3$.

Professor Roscoe has succeeded in obtaining bromine and iodine compounds of vanadium, and also various metallic vanadates. He went on with his lecture by pointing out that the characters of the vanadates bear out the analogy of the vanadic acid with the highest oxides of phosphorus and arsenic; and stated, in conclusion, that vanadium, hitherto standing in no definite relation to other elements, must now be regarded as a member of the well-known triad class of elementary substances, comprising nitrogen, phosphorus, boron, arsenic, antimony, and bismuth.

The President, in proposing a vote of thanks to the lecturer, called attention to the great service Professor Roscoe had rendered to chemical science by his successful investigation of vanadium.

After the delivery of this lecture, Professor Hofmann, from Berlin, favoured the Society with a few observations on an organic body he had obtained by treating sulpho-urea with silver oxide. This substance, CH_2N_2, is distinguished by its great tendency to polymerise.

Dr. Hofmann further communicated that a compound isomeric with chloral had recently been discovered by two Berlin chemists. It differs from ordinary chloral by its much higher boiling point.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, March 22nd, 1870.

E. W. Binney, F.R.S., F.G.S., Vice-President, in the Chair

The following extract of a letter, dated March 21st, 1870, from Sir W. Thomson, D.C.L., F.R.S., Hon. Member of the Society, to the President, was read:—

I have now, at last, got into good working-order measurements of electrostatic capacity (which, perhaps, you may remember I was working on the first time you ever came to see me, and more or less almost ever since). I have two students of last year, junior assistants in my laboratory, measuring electrostatic capacities of condensers, and variations of specific inductive capacities of resistance, with sensibility of 1-10th per cent, and with constancy, in spite of accidental variations, generally within $\frac{1}{2}$ or $\frac{1}{4}$ per cent.

My occupation on the kinetic theory of gases has led me, at last, to come to definite terms as to the size of molecules. Ever since about the first year of my Professorship, I have taught my students that Cauchy's theory of dispersion proves heterogeneousness, or molecular structure, to become sensible in contiguous portions of glass or water of dimensions moderately small in comparison with the wave-lengths of ordinary light. I have spoken to you also, I think, of the argument deducible from the contact-electricity of metals. This, I now find, proves a limit to the dimensions of the molecules in metals quite corresponding to that established for transparent solids and liquids by the dynamics of dispersion. In experiments made about ten years ago, of which a slight sketch is published in the *Proceedings of the Literary and Philosophical Society of Manchester*, I found that a plate of zinc and a plate of copper, kept in metallic connection with one another (by a fine wire or otherwise), act electrically upon electrified bodies in their neighbourhood, and upon one another, as they would if they were of the same metal and kept at a difference of potentials equal to about three-quarters of that produced by a single cell of Daniell's. Hence, and from my measurement of the electrostatic effects of a Daniell's battery, published in the *Proceedings of the Royal Society* for February and April, 1860, I find that plates of zinc and copper, held parallel to one another at any distance (D) apart which is a small fraction of the linear dimensions of their opposed surfaces, and kept in metallic communication with one another, exercise a mutual attraction equal to—

$$2 \times 10^{-10} \times \frac{A}{D^2} \text{ grms. weight.}$$

Hence, if they were allowed to approach from any greater distance (D′) to the distance D, the work done by their mutual attraction is—

$$2 \times 10^{-10} \times \frac{A(D'-D)}{D'D} \text{ centimetre grms.;}$$

which, if D is very small in comparison with D′, is very approximately equal to—

$$2 \times 10^{-10} \times \frac{A}{D}$$

Now, suppose a pile to be made of a great number (N+1) of very thin plates alternately of zinc and copper, kept in metallic connection while they are brought towards one another. Let their positions in the pile be parallel, with narrow spaces intervening. For simplicity, let the thickness of each metal plate and intervening space be D. The whole work done will be—

$$2 \times 10^{-10} \times N\frac{A}{D}$$

The whole mass of the pile, if we neglect that of one of the end plates, is $NAD\rho$, where ρ denotes the mean of the densities of zinc and copper. Hence, if h be the height to which the whole mass must be raised against a constant force equal to its weight at the earth's surface, to do the same amount of work, we have—

$$NAD\rho h = 2 \times 10^{-10} \times N\frac{A}{D}$$

which gives—

$$h = \frac{2 \times 10^{-10}}{\rho D^2}$$

or, as $\rho = 8$, nearly enough for the present rough estimate,

$$h = \frac{1}{(2000000D)^2}$$

Hence, if—

$$D = 1\text{-}200{,}000\text{th centimetre,}$$
$$h = 1 \text{ centimetre.}$$

The amount of energy thus calculated is not so great as to afford any argument against the conclusion which general knowledge of divisibility, electric conductivity, and other properties of matter, indicates as probable—that, down to thicknesses of 1-200,000th of a centimetre for the metal plates and intervening spaces, the contact electrification, and the attraction due to it, follow with but little, if any, sensible deviation

the laws proved by experiment for plates of measurable thickness with measurable intervals between them. But, let D be 1-200,000,000th of a centimetre: if the preceding formulæ were applicable to plates and spaces of this degree of thinness, we should have—

$$h = 1{,}000{,}000 \text{ centimetres, or } 10 \text{ kilometres.}$$

The thermal equivalent of the work thus represented is about 248 times the quantity of heat required to warm the whole mass (composed of equal masses of zinc and copper) by 1° C. This is probably more than the whole heat of combination of equal masses of zinc and copper melted together; for it is not probable that the compound metal, when dissolved in an acid, would show anything approaching to so great a deficiency in the heat evolved below that evolved when the metallic constituents are separately dissolved,* and their solutions mixed. But the experiment should be made. Without any such experiment, however, we may safely say that the fourfold amount of energy indicated by the preceding formula for a value of D yet twice as small is very much greater than any estimate which our present knowledge allows us to accept for the heat of combination of zinc and copper. For something much less than the thermal equivalent of that amount of energy would melt the zinc and copper; and, therefore, if in combining they generated by their mutual attraction any such amount of energy, a mixture of zinc and copper filings would rush into combination (as the ingredients of gunpowder do) on being heated enough in any small part of the whole mass to melt together there. Hence we may infer that the electric attraction between metallically-connected plates of zinc and copper of only 1-400,000,000th of a centimetre thickness, at a distance of only 1-400,000,000th of a centimetre asunder, must be greatly less than that calculated from the magnitude of the force and the law of its variation observed for plates of measurable thickness, at measurable distances asunder. In other words, plates of zinc and copper, so thin as 1-400,000,000th of a centimetre, and placed at as short a distance as 1-400,000,000th of a centimetre from one another, form a mixture closely approaching to a molecular combination, if, indeed, plates so thin could be made without splitting atoms.

Wishing to avoid complication, I have avoided hitherto noticing one important question as to the energy concerned in the electric attraction of metallically-connected plates of zinc and copper. Is there not a change of temperature in molecularly-thin strata of the two metals adjoining to the opposed surfaces, when they are allowed to approach one another, analogous to the heat produced by the condensation of a gas, the changes of temperature produced by the application of stresses to elastic solids which you have investigated experimentally, and the cooling effect I have proved to be produced by drawing out a liquid film which I shall have to notice particularly below? Easy enough experiments on the contact-electricity of metals will answer this question. If the contact-difference diminishes as the temperature is raised, it will follow from the second law of thermodynamics (by reasoning precisely corresponding with that which I applied to the liquid film in my letters to you of February 2nd and February 3rd, 1858 †) that plates of the two metals, kept in metallic communication and allowed to approach one another, will experience an elevation of temperature; but, if the contact-difference increases with temperature, the effect of mutual approach will be a lowering of temperature. On the former supposition, the diminution of intrinsic energy in quantities of zinc and copper, consequent on mutual approach with temperature kept constant, will be greater, and, on the latter supposition, less than I have estimated above. Till the requisite experiments are made, further speculation on this subject is profitless; but, whatever be the result, it cannot invalidate the conclusion that a stratum of 1-200,000,000th of a centimetre thick cannot contain in its thickness many, if so much as one, molecular constituent of the mass.

* Will you try this experiment? You would easily make a good thing of it.

† *Proceedings of the Royal Society* for April, 1858.

Besides the two reasons for limiting the smallness of atoms or molecules which I have now stated, two others are afforded by the theory of capillary attraction and Clausius's and Maxwell's magnificent working out of the kinetic theory of gases.

In my letters to you already referred to, I showed that the dynamic value of the heat required to prevent a bubble from cooling when stretched is rather more than half the work spent in stretching it. Hence, if we calculate the work required to stretch it to any stated extent, and multiply the result by $\frac{3}{2}$, we have an estimate, near enough for my present purpose, of the augmentation of energy experienced by a liquid film when stretched and kept at a constant temperature. Taking 0·08 of a gramme weight per centimetre of breadth as the capillary-tension of a surface of water, and, therefore, 0·16 as that of a water-bubble, I calculate (as you may verify easily) that a quantity of water, extended to a thinness of 1-200,000,000th of a centimetre, would, if its tension remained constant, have more energy than the same mass of water in ordinary condition by about 1100 times as much as suffices to warm it by 1° C. This is more than enough (as Maxwell suggested to me) to drive the liquid into vapour. Hence, if a film of 1-200,000,000th of a centimetre thick can exist as liquid at all, it is *perfectly certain* that there cannot be many molecules in its thickness.

The argument from the kinetic theory of gases leads me to quite a similar conclusion.

Ordinary Meeting, April 5th, 1870.

J. P. Joule, D.C.L., LL.D., F.R.S., &c., President, in the Chair.

"*Description of a New Anemometer.*" By Peter Hart.

On the appearance of Mr. Fletcher's admirable paper "On the Speed of Air in Flues," it appeared to me that an anemometer more easily read and less costly than his was desirable. With this view I devised the present one, which may be broadly described as a common U-tube gauge laid in a sloping position, so as to form the hypotenuse of a right-angled triangle, the perpendicular of which is the true reading.

The following description will explain its construction:—

It consists first of a base board furnished with levels and levelling screws; to this is hinged the board carrying the U-tube, which may be called the sloping base; on this sloping base is secured the U-tube furnished with a scale and vernier capable of being read to the 1-100th inch. By means of a screw passing through the sloping base, and resting on the lower base board, the former can be made to assume any angle with the latter, the angle being determined by a quadrant fixed to the lower base board.

By this arrangement a very great degree of accuracy in reading is obtainable. Thus, in the present instrument, the quadrant is set 5 inches distant from the hinge, and when set at 0·5 inches on the quadrant, it gives a rise of 1 in 10; consequently, the ether in the U-tube has to move 10 inches for 1 inch of vertical rise. The rule for getting the result may be stated thus:—

Divide the space between the hinge and the quadrant by the quadrant elevation, now divide the movement of the ether by the quotient, and the product is the true vertical movement *nearly*.

Thus, suppose, as before, the quadrant elevation to be 0·5 inch, the distance from hinge to quadrant 5·0 inches, and the ether's movement 1 inch: then—

$$\frac{5}{0{\cdot}5} = 10 \text{ and } \frac{1{\cdot}0}{10} = 0{\cdot}1 \text{ inch.}$$

Or again, the quadrant elevation being 0·2 inch, the other quantities the same: then—

$$\frac{5}{0{\cdot}2} = 0{\cdot}25 \text{ and } \frac{1{\cdot}0}{1{\cdot}25} = 0{\cdot}04 \text{ inch.}$$

These results, though not absolutely correct, will, in most cases, be sufficiently so; but where rigid accuracy must be had, the following table will supply the means:—

Quadrant Elevation in 10 inches.	Hypotenuse.	Quadrant Elevation in 10 inches.	Hypotenuse.
0·1 inch.....	10·00049	1·1 inch.....	10·06035
0·2 "	10·00199	1·2 "	10·07174
0·3 "	10·00449	1·3 "	10·08414
0·4 "	10·00799	1·4 "	10·09752
0·5 "	10·01248	1·5 "	10·11187
0·6 "	10·01799	1·6 "	10·12714
0·7 "	10·02447	1·7 "	10·14347
0·8 "	10·03199	1·8 "	10·16061
0·9 "	10·04049	1·9 "	10·17888
1·0 "	10·04987	2·0 "	10·19803

First find what aliquot part of 10 the quadrant elevation was; find this in the quadrant column. Opposite this will be found a number which is the hypotenuse. Then, as this number is to 10, so is the number obtained by the first method to the true number.

Thus, to take the first illustration, of 0·5 in 5 inches: this is equal to 1 in 10. The hypotenuse of 1 in 10 (see table) = 10·04987. Now, 0·1 inch was the result obtained. Then, as 10·04987 : 10 : : 0·1 : 0·09955, which is the true vertical rise.

I had no little difficulty in my first efforts to restrain the excessive oscillations of the ether column, owing to the almost constant fluctuations of draught in flues. To obviate this the tube was choked to a narrower bore at the bend. This proving insufficient, I overcame the defect by the very simple means of inserting a piece of sponge at this part.

It is, perhaps, needless to add that it is necessary to employ Mr. Fletcher's tubes for insertion into the flue, and also his tables.

ROYAL INSTITUTION OF GREAT BRITAIN.

Friday, April 1st, 1870.

"*On the Artificial Production of Alizarine, the Colouring Substance of Madder,*" by Prof. H. E. Roscoe, F.R.S., Owen's College, Manchester.

The speaker stated that he had to bring before the notice of his audience a discovery in organic chemistry which, whether we regard its scientific interest or its practical and commercial value, is of the highest importance, and marks an era in the history of the application of chemistry to the arts and manufactures even of greater importance than the memorable discovery made by Mr. Perkin in 1856 of the production of aniline violet, or mauve.

Since the above-named year, great progress has been made in the theoretical investigation of natural and artificial colouring matters, as well as in their preparation on a large scale. The chemistry of colouring matters has now taken a high and important position, and chemists instead, as formerly was their wont, of getting rid of all colouring matters as something foreign to their objects of investigation, have, since Mr. Perkin's discovery, found out that the examination of colouring matters may not only lead to scientific laurels, but may sometimes yield fruit of another and not less acceptable kind.

We owe to the brains and hands of two German chemists, Messrs. Graebe and Liebermann, this remarkable discovery, which differs from all the former results which have been brought about by the application of science to the chemistry of colouring matters, inasmuch as this has reference to the artificial production of a natural vegetable colouring substance which has been used as a dye from time immemorial, and is still employed in enormous quantities for the production of the pink, purple, and black colours which are seen everywhere on printed calicoes, viz. alizarine, the colouring principle of madder.

It is from the liquid tarry products of the destructive distillation of coal, a rich source of interest to chemists, that we now derive this new colouring matter.

The following table contains the results of experiments made on the large scale, indicating the various yields of tar from different qualities of coal distilled in the gas-works of various towns:—

Destructive Distillation of Coal.

100 tons of cannel and bituminous coal distilled to yield 10,000 cubic feet of gas of sp. gr. 0·6, yield the following products:—

	Gas.	Tar.	Ammonia Water.	Coke.	
1	22·25	8·50	9·50	59·75	Average of many experiments.
2	20·01	7·85	7·14	65·00	Manchester.
3	20·40	6·40	5·40	67·85	Dukinfield.
4	21·70	7·50	5·80	65·00	Macclesfield.
5	16·30	10·70	8·00	65·00	Salford.

From a careful series of experiments made by a large tar distiller, the following numbers are derived, showing the average composition of gas tar:—

100 tons of tar on distillation yield:—

	Naphtha.	Light Oils, and Carbolic Acid.	Heavy Oils, Naphthalene, Anthracene.	Pitch.	Water, Gas, and Loss.
1.	3·0	1·5	35·0	50·0	10·5
2.	3·0	0·8	25·0	60·0	12·2

It is from benzol, C_6H_6, discovered by Faraday in 1825, that the aniline colours are all of them prepared. The colour-producing power of the coal products is, however, yet far from being exhausted. It is by means of another, and hitherto comparatively unknown, hydro-carbon, anthracene, $C_{14}H_{10}$, that the newest triumphs of the chemist have been won. This is a substance which in the pure state few chemists (even yet) have seen, and upon which only two or three had previously experimented, and yet by one happy discovery—and by an investigation which more than almost any other exhibits the value of the synthetic power of modern research—this unknown body has been made to yield a colouring matter of the greatest possible value. The truth of this will at once be evident when we learn that the total growth of madder is estimated to reach 47,500 tons per annum, worth £45 per ton, and having, therefore, a value of £2,150,000. Of this, nearly one-half is used in the United Kingdom, so that no less a sum than £1,000,000 is now paid by us for madder grown in foreign countries. This will now, in part at least, go to benefit our own population, as we can now transform our coal into this invaluable colouring matter.

In an experiment made on a large scale it was found that 100 tons of tar yielded 0·63 ton of anthracene, or 1 ton of anthracene can be obtained from the distillation of about 2000 tons of coal, not reckoning the quantity of anthracene contained in the pitch.

Madder is the root of several species of Rubia, amongst which the *Rubia tinctorum* is the most valued for its dyeing properties. This grows in Holland, Asia Minor, and in the south of France and of Russia. A species native to England is the *Rubia peregrina*. This belongs to the order *Rubiaceæ*, the native members of which, as the Galiums, are mostly inconspicuous wild plants. Some of the foreign species are, on the contrary, important plants, such as the cinchona, ipecacuanha, and coffee plants, and these are distinguished for the number and variety of the peculiar principles which they yield, as quinine, cinchonine, caffeine, alizarine. Thanks to the kindness of Dr. Schunck, the speaker was able to show a young madder plant.

In spite of the many investigations which have been made of madder, chemists are still in doubt as to the nature of many of its constituents. Some attribute its colouring powers to the presence of at least two substances—alizarine and purpurine—while others say that only one of these produces the true madder colours.

Alizarine was discovered and obtained from madder, as a crystalline sublimate, by Robiquet and Colin, in 1831, but little importance attached to this discovery until Schunck, in 1848, showed that all the finest madder colours contain only alizarine combined with bases and fatty acids. The second colouring matter, termed purpurine, was discovered by Persoz. It contributes to the full and fiery red colour in ordinary madder dyeing, but dyes a bad purple, alizarine being essential to the latter. Purpurine disappears during the purifying processes of soaping, &c, being far less stable than alizarine. It is distinguished from alizarine by its solubility in boiling alum liquor.

These two colouring principles may likewise be easily distinguished by the spectrum, alizarine producing a set of dark absorption bands, quite different from those of purpurine, which again vary according to the nature of the solvent. Alizarine can be obtained in yellow needle-shaped crystals by simple sublimation from the dried madder; but this colouring matter is, singularly enough, not contained ready formed in the fresh madder root, but is the product of a peculiar decomposition. For a proof that fresh madder does not contain alizarine we have only to extract the moist root with alcohol, when neither the alcoholic extract nor the insoluble residue will be found to possess tinctorial power. We owe this knowledge to the researches of Schunck and Higgin, who have proved that alizarine is produced by a peculiar kind of fermentation, which partly occurs in the root on standing, and partly takes place in the dyebeck, when the powdered madder is treated with water. A crystalline glucoside, termed rubianic acid (Schunck), is contained in the root, and it is this which splits up simply into alizarine glucose. This acid crystallises in fine yellow needles, and gives a definite and crystalline potash salt, from which it was shown to contain 26 atoms of carbon in the molecule. Hence, as no other product but glucose is formed, it follows that alizarine must contain $C_{26} - C_{12} = C_{14}$. This decomposition of rubianic acid into alizarine was shown by boiling with an acid, and adding caustic soda when the blue solution of alkaline alizarine was seen. The formation of alizarine in extracts of madder root is effected by a ferment peculiar to the plant, and called erythrozym. It is a ferment *sui generis*, since no other ferment produces the same effect. When mixed with a solution of rubian or rubianic acid, at the ordinary temperature, the latter is rapidly decomposed as with acids. This is what takes place in making *fleur de garance*. Dyers raise the temperature of their madder-baths gradually up to the boiling point, because the application of a high temperature destroys the ferment. When the temperature is gradually raised, the ferment acts upon the glucoside, and produces alizarine.

That the colouring matter in fresh madder root is not alizarine can be easily shown by rubbing the soft portions of the root on to paper, when a yellow stain will be produced, which, on treatment with an alkali, shows the bright red colour of an alkaline solution of rubian instead of the blue solution of alizarate.

According to Schunck, the origin of purpurine, and its relation to alizarine, are still involved in obscurity.

The hypothesis which of late years has done more than any other to stimulate experiment and enlarge our views in organic chemistry is undoubtedly Kekulé's theory of the tetrad nature of carbon and his explanation of the constitution of the carbon compounds. In the so-called paraffine group of organic substances, the carbon atoms are supposed to be connected together by single links of the four bonds attached to each atom, thus giving rise to saturated compounds by the attachment of other elements or radicals to the free bonds. In the group of aromatic substances with which we are specially concerned the carbon atoms are more closely linked together, or, in other words, a less number of atoms of hydrogen are necessary to saturate an aggregation of carbon atoms than is the case in the other group. We can explain this, upon the assumption of the tetrad character of carbon, by supposing that each carbon atom is attached to its neighbour alternately by one and by two bonds.

Another singular property of these aromatic bodies is that they all contain at least six atoms of carbon, and that the simplest hydrocarbon of which they are made up is benzol, C_6H_6. So that we may regard all these aromatic compounds as benzol derivatives, and this hydrocarbon may be considered as the skeleton round which many complicated substances are arranged. So that by the replacement of one atom of hydrogen by NH_2, we obtain aniline, by OH phenol, &c. From the knowledge gained by his investigation on the quinones, Graebe came to the conclusion that alizarine belongs to the quinone series; and, availing themselves of Baeyer's reaction, by which phenol can be converted into its hydrocarbon, benzol, Graebe and Liebermann passed the vapour of natural alizarine obtained from madder over heated zinc-dust, and found that the hydrocarbon they formed was identical in all its properties with anthracene, $C_{14}H_{10}$, from coal tar. Hence they confirmed Schunck's conclusions that the molecule of alizarine contains fourteen atoms of carbon. Having thus got hold of the backbone, as it were, of the compound, it only remained for them to clothe the hydrocarbon with the four additional atoms of oxygen and to take off the two atoms of hydrogen in excess, in order to obtain alizarine.

Laurent and also Anderson had, many years ago, obtained a body of the composition $C_{14}H_8O_2$, and Graebe recognised this as the quinone of anthracene; and he now only required to replace in this two atoms of hydrogen by two of hydroxyl (OH), in order to obtain alizarine, which clearly appeared to be a quinone acid—

$$C_{14}H_{10} \qquad C_{14}H_8(O'')_2 \qquad C_{14}H_6\left\{\begin{matrix} O_2'' \\ OH \\ OH \end{matrix}\right.$$

Anthracene. Anthraquinone. Alizarine.

This replacement of hydroxyl can be effected by bromine, by which bibromanthraquinone $C_{14}H_6Br_2O_2$ is formed, and this, on fusion with caustic potash, gives potassium alizarate, yielding pure alizarine on treatment with hydrochloric acid. The high price of bromine rendered this process unavailable for manufacturing purposes, and hence another plan was simultaneously proposed by several chemists for effecting the same end in a cheaper mode. Use was hereby made of Kekulé's and Wurtz's reaction in the formation of sulphobenzolic acid. On treating anthraquinone with strong sulphuric acid to a high temperature, the di-sulpho acid—

$$C_{14}H_6O_2\left\{\begin{matrix} SO_3H \\ SO_3H \end{matrix}\right.$$

is formed, and this on heating with concentrated solution of potash, yields the sulphite and alizarate of potassium; from the latter substance pure alizarine is obtained by the action of acids.

In the following table we have a statement of the synthetic production of alizarine from its constituent elements.

SYNTHESIS OF ALIZARINE.

1. Acetylene by direct union of carbon and hydrogen in electric arc.

$$C_2 + H_2 = C_2H_2 \qquad \text{(Berthelot, 1862.)}$$

2. Benzol (tri-acetylene) from acetylene by heat.

$$3C_2H_2 = C_6H_6 \qquad \text{(Berthelot, 1866.)}$$

3. Anthracene from benzol and ethylene.

$$2C_6H_6 + C_2H_4 = C_{14}H_{10} + 3H_2 \qquad \text{(Berthelot, 1866.)}$$

4. Alizarine from anthracene. (Process No. 1.)

(Graebe and Liebermann, 1869.)

(A) Oxyanthracene or anthraquinone by nitric acid.

$$C_{14}H_6(OH)_2 \qquad \text{(Anderson, 1861.)}$$

(B) Bibromanthraquinone by action of bromine.

$$C_{14}H_8O_2 + 2Br_2 = C_{14}H_6Br_2O_2 + 2BrH$$

(C) Alizarine by action of caustic potash.

$$C_{14}H_6Br_2O_2 = 4KHO = \underset{\text{Potassium alizarate.}}{C_{14}H_8(OK)_2O_2} + 2KBr + 2H_2O$$

[English Edition, Vol. XXI., No. 543, pages 185, 186.]

5. Alizarine from anthracene. (Process No. 2.)
(Graebe and Caro, Perkin, Schorlemmer, and Dale.)

(A) Disulphoanthraquinonic acid from anthraquinone.

$$C_{14}H_6(OH)_2+2H_2SO_4=C_{14}H_6O_2\left\{\begin{matrix}SO_3H\\SO_3H\end{matrix}\right\}+2H_2O$$

(B) Alizarine from the above by the action of potash.

$$C_{14}H_6O_2\left\{\begin{matrix}SO_3H\\SO_3H\end{matrix}\right\}+4KHO=$$
$$=\underset{\text{Alizarine.}}{C_{14}H_6O_2\left\{\begin{matrix}OH\\OH\end{matrix}\right\}}+2K_2SO_3+2H_2O$$

Mr. Perkin states that an intermediate substance is formed in this reaction having the formula—

$$C_{14}H_6(O)_2''\left\{\begin{matrix}OK\\OSO_3,\end{matrix}\right.$$

and this, when heated with potash, splits up into alizarine and a sulphite. Other yellow-coloured products are, according to Perkin, contained in the alizarine as sent out from his manufactory. The nature of these yellow crystalline bodies is as yet unknown.

Of the identity of the natural with the artificial alizarine there can be no doubt: they agree in all their physical and chemical properties. Their absorption spectra are identical, their tinctorial powers are the same; the coloured lakes which they form with alumina, iron, and copper salts, are of the same tint, and possess the same degree of solubility, and these remain alike unaltered by the action of light, so that when they are fixed in the cotton-fibre they yield equally fast colours.

It is difficult to predict how far the artificial alizarine will in future restrict the growth of madder; but there is no doubt that for many styles of calico-printing the artificial alizarine is of the greatest value, and we may naturally expect to see very important changes effected in this branch of chemical industry in the further practical application of this new discovery.

Contributions to the History of Alizarine. $C_{14}H_8O_4$.

1825. Faraday discovered benzol in coal-gas oil. C_6H_6.
1831. Robiquet and Colin discovered alizarine in madder root.
1832. Dumas and Laurent discovered anthracene in coal oils.
1848. Schunck gave the composition of alizarine, $C_{14}H_{10}O_4$.
1850. Strecker gave the composition of alizarine, $C_{18}H_8O_3$.
1862. Anderson examined anthracene compounds, $C_{14}H_{10}$.
1865. Kekulé explained the constitution of the aromatic compounds.
1866. Baeyer obtained benzol from phenol.
1868. Graebe investigated the quinones.
1868. Graebe and Liebermann obtained anthracene from alizarine.
1869. Graebe and Liebermann obtained alizarine from anthracene.

NOTICES OF BOOKS.

The Private Life of Galileo. Compiled principally from his correspondence, and that of his eldest daughter, Sister Maria Celeste, Nun in the Franciscan Convent of S. Matthew, at Arcetri. London: Macmillan and Co. 1870. 307 pages.

We are extremely glad to welcome the issue of another life of Galileo; for, although many such have been published, they have, for the most part, appeared in Italy and France, and are but little known in this country. The most detail work is perhaps Albèri's "Opere Complete di Galileo Galilei," which was published in Italy, between 1842 and 1856. In this country, we scarcely know where to look for a work which gives anything like a definite idea of Galileo's works, of his life, and of the times in which he lived; and, although the work before us purports to be confined to his private life, it contains many interesting details in regard to his scientific labours, and his persecution by the Church of Rome.

Galileo was the eldest son of Vincenzio de' Bonajute de' Galilei, a Florentine nobleman, and was born at Pisa, on the 18th of February, 1564. His father appears to have been a man of great culture, and was the author of several works on counterpoint, which, having been invented about the twelfth century, had attained some degree of perfection by the sixteenth. Galileo acquired a great love for music from his father, and is said to have excelled him as a performer on the lute; throughout his life, especially when blindness and bodily ills were added to his other troubles, he delighted in the soothing effect of his instrument. In painting Galileo also excelled, and it is probable that, if he could have chosen his profession, he would have become a painter.

In 1581, at the age of seventeen, Galileo was sent to study medicine at the University of Pisa, an intensely conservative institution, where Aristotle, and Aristotle only, was considered the fountain-head of all knowledge.

It was during his residence at Pisa that he discovered the pendulum. He noticed the extreme regularity of the oscillation of the great bronze lamp in the nave of the Cathedral, and was thus led to imagine that an instrument might be constructed which, by the alternation of its oscillations, would mark the regularity and variation of the pulse. This instrument he constructed, and it was much used by the physicians of the day, under the name of *pulsilogia*.

When we remember how great a mathematician Galileo became, it is strange to learn that the study of mathematics was entirely neglected in the University of Pisa, and, indeed, in Italy generally. It was considered a waste of time to solve problems, and the name of Euclid was almost unknown; indeed, Galileo was obliged to pursue his mathematical studies clandestinely, and it was only when his father saw that he possessed an extreme aptitude for them that he permitted them to be continued. Accordingly, Galileo worked hard at the writings of Euclid and Archimedes; he reached the sixth book of the former, and had already invented several problems. In 1586, while studying the works of Archimedes, he composed his first essay on the "Hydrostatic Balance," which was not published, however, till 1615. In 1588, he wrote his "Theoremata Circa Centrum Gravitatis Solidarum," which was not published till 1638, and then in the form of an appendix to the fourth of the celebrated "Dialogues." The "Essay on the Centre of Gravity of Bodies" led to the introduction of Galileo to Ferdinand, Grand Duke of Tuscany, who appears to have admitted him to a considerable degree of intimacy. In 1589, Galileo was appointed Professor of Mathematics at Pisa, with a salary of sixty crowns per annum, that is, about ten-pence per day. With one exception, Galileo had not a friend among the Pisan Professors, for they were firm believers in Aristotle; and, when Galileo proved the falsity of Aristotle's laws regarding falling bodies by experiments in public, made on the summit of the Leaning Tower of Pisa, the anger of his colleagues was soon made manifest. In 1592, Galileo resigned the Professorship at Pisa, and became Professor of Mathematics in the University of Padua, with a salary of 180 florins a-year (about £32). The Paduans recognised his genius somewhat tardily: when he had been among them seventeen years, the Senate of the University, bearing in mind his discovery of the telescope, and his labours "to the gain of the University, and to the satisfaction of all," gave him the Professorship for life, with a salary of a thousand florins.

In 1609, Galileo invented the telescope. It was first called *cannocchiale* or *occhiale* (eye-glass); and the term *telescope* was introduced by Prince Fredrigo Cesi. The invention was very much combated, even by Galileo's own countrymen; it was claimed by the Dutch, and many older

writers (among them Baptista Porta and Antonio De Dominis) were mentioned as prior inventors. By means of the new instrument, Galileo discovered the satellites of Jupiter, in 1610; he called them *Medicea Sidera*, in honour of Cosmo de' Medici and his brothers, Francesco, Carlo, and Lorenzo. Galileo constructed more than a hundred telescopes, and sent them as presents to various monarchs and princes of Europe; only ten of them were capable of showing the satellites of Jupiter. The excitement created by the invention was intense; everyone was anxious to see the new instrument: "we are told how Marie de' Medici, in her eagerness to see the moon through the telescope, would not wait for it to be adjusted, but went down upon her knees before the window, thereby greatly astonishing the Italian gentleman who had brought the telescope into the royal presence." In July, 1610, Galileo discovered Saturn's Ring; in the following October, the phases of Venus; and, in March, 1611, the solar spots.

In 1613, Fra Benedetto Castelli, a pupil of Galileo, was appointed Professor of Mathematics at Pisa, but was specially cautioned to make no mention of the Copernican theory of the earth's motion, which, since the discovery of Jupiter's satellites, had been somewhat openly discussed. Galileo wrote to Castelli, during the course of this same year, on the subject of the Copernican theory, and asserted that the Ptolemaic system (then received by the Church) did not, in many respects, accord with Scripture. We may quote a few passages of this celebrated letter in full:—"But I should in your place have added that, though Scripture cannot err, its expounders and interpreters are liable to err in many ways; and one error in particular would be most grave and most frequent if we always stopped short at the literal signification of the words. For, in this wise, not only many contradictions would be apparent, but grave heresies and blasphemies; for then it would be necessary to give God hands, and feet, and ears, and human and bodily emotions, such as anger, repentance, hatred, and sometimes forgetfulness of things past, and ignorance of the future." . . . "And who can assert or sustain that, in speaking incidentally of the sun, or of the earth, or of other created bodies, Scripture should have elected to restrain itself rigorously to the strict signification of the words used? May it not be that, had the truth been represented to us bare and naked, its intention would have been annulled, from the vulgar being thereby rendered more contumacious and difficult of persuasion in the articles concerning their salvation?" A copy of this private letter, obtained, it is believed, by treachery, fell into the hands of the Dominicans of the Convent of S. Mark, and incensed them to such a degree that they determined at once to denounce Galileo to the Holy Office, and, if possible, procure his destruction. The controversy was immediately introduced into the pulpit; and the Dominican Caccini preached a violent anti-Copernican sermon, at S. Maria Novella, on the punning text, "Ye men of Galilee, why stand ye gazing up into Heaven?" The opponents of Copernicus (who, in reality, knew nothing about him) forgot that he was a Canon of their Church, and had been summoned to Rome by Leo X., to the Council of the Lateran, in order to re-model the Church Calendar. Caccini was ordered to repair to Rome, and was examined in March, 1615, in regard to what he knew of Galileo and his followers. Both Caccini and Lorini denounced Galileo to the Holy Office, and thus paved the way to the celebrated trial of 1633. Near the close of the year 1615, Galileo went to Rome to plead his own cause. Early in the following year, he had an interview with the Pope (Paul V.), who conversed with him for three-quarters of an hour, and was altogether very gracious, assuring him that he need fear no persecution by the Congregation of the Holy Office, during his Pontificate. Paul V. died in 1621, and Gregory XV. was elected in his stead, but he reigned only two years; and, in August, 1623, Maffeo Barbarini became Pope, and assumed the title of Urban VIII. When Cardinal, the new Pope had been on somewhat intimate terms with Galileo; had called him "affectionate brother," and had written Latin sonnets in praise of his works. It was hence imagined by the reform party that science would find a patron and protector in Urban; Galileo, indeed, went so far as to hope and imagine that he would recognise the Copernican theory. "Under the auspices of this most excellent, learned, and benignant Pontiff," wrote Prince Cesi, "science must flourish. . . . Your arrival will be welcome to his Holiness. He asked me if you were coming, and when; and, in short, he seems to love and esteem you more than ever." In April, 1624, Galileo started for Rome, where he remained about two months, during which time he had six interviews with the Pope, who gave him various presents on his departure, and "an ample provision of Pontifical love."

Galileo's "Dialogue on the Ptolemaic and Copernican Systems" had for many years been partially written. It was finally concluded in March, 1630; and, in the following May, Galileo went to Rome to make arrangements for its publication. Urban VIII. gave him permission to publish the work with certain slight alterations and additions: but, at the same time, to his great disappointment, told him that the Copernican system could not be recognised by the Church, and must be treated as mere hypothesis. The "Dialoghi" appeared in January, 1632, and was favourably received by all Italy. Suddenly, however, about six months after its appearance, an order was issued from the Master of the Sacred Palace to sequestrate every copy throughout Italy, on the authority of the Jesuit Inchofer, one of the Consultori. The Grand Duke of Tuscany, the principal patron of Galileo, wrote at once to Niccolini, his Ambassador at Rome, to enquire the cause of the sudden change of the Pope's views. Niccolini at once requested an audience. When Galileo was mentioned, Urban became furious; he said he had grossly deceived him, and had dared to publish matters which ought never to have been so much as mentioned; moreover, that the Papal suggestions had not been complied with. The Jesuits ruled the Roman Court then, as now; and certain Jesuits of influence instilled into the Pope's mind the fabrication that, in the person of Simplicio (one of the three characters in the "Dialogues"), Galileo had intended to hold him, the Sovereign Pontiff, up to ridicule. This, once admitted by Urban, sealed the fate of Galileo and of his work. In October, 1632, he was cited to appear at once before the Inquisition; and, although everything was urged against his appearing in person for trial, the Pope would listen to no excuse. Galileo was very old and feeble, and his health was bad. It must be confessed that the three doctors who drew up the medical certificate of the state of his health made the very best case they could for their client, in regard to his unfitness for the journey to Rome. They found him to possess an intermittent pulse and a certain amount of debility; then comes the heaping up of bodily ills—"Riferisce il detto patire di vertigini frequenti, di melancolia hipocondriaca, debolezza di stomaco, vigilie, dolori vaganti per il corpo, si come da altri può essere attestato. Co se anco haviamo riconosciuto un hernia carnosa grave con attentatum del peritoneo." It was no use, however; the Inquisition would not spare him; and he was forced to make the journey to Rome during mid-winter, through a bleak and dreary region.

Now, his trial and the results thereof, and his abjuration, and imprisonment, and the sentence (which included a recitation of the seven penitential Psalms once a week for three years), are they not written in numerous and diverse books, and, to a greater or less extent, in the minds of all of us? One thing we must allude to, in conclusion: it is usually said that, when Galileo rose from his knees, after abjuring the doctrine of the earth's mobility, he muttered—*Eppure si muove!* ("It *does* move, notwithstanding"). The author of the work before us very justly remarks,—"This is one of those fine things which are put into the mouths of great men, but which, in fact, are not said, except by their biographers. It is, indeed, impossible that Galileo

should have uttered such words as would have caused his instant consignment to the deepest dungeons of the Inquisition." We remember a recent example of these fine sayings which are put into the mouths of great men. When the Tsar was fired at, in 1867, during his visit to Napoleon III., there were no less than *seven* different statements, in various Paris papers, of the sayings of the Emperor and the Tsar the moment after the shot had been fired. These sayings were so evidently dramatic in their character, and unlike the real remarks which might be expected to be made under such circumstances, that the wonder is they obtained a moment's credence. We remember but one of them—"Sire," said Napoleon III., "we have been under fire together." "Our destinies," replied the Tsar, "are in the hands of Providence." M. Ponsard has not allowed such an incident as the *Eppure si muove* saying to pass unnoticed in his "Galilée;" indeed, he makes it the culminating-point of the drama, and also ingeniously gives Mde. Favart a last chance of showing her filial affection as Antonia—

"*Le President, à Galilée.*
Ls prison qu'on t'assigne est un cloître à Livourue,
Antonia, se jetant dans les bras de Galilée.
Vs, nous t'y suivrons, père.
Galilée, à part, en se relevant et en frappant du pied en terre.
Et pourtant elle tourne."

Let us add one word, in conclusion, in regard to the treatment of Galileo by the Church, and his actual position. It has been the custom to see in him only an injured and persecuted man; to absorb everything appertaining to the man into the martyr. A lot of nonsense and rant has been written against the Church of Rome, because it suppressed his book; while we forget what our own Church, which pretends to no bigotry, has done; and how, even now, more than two centuries from the time of Galileo, a very little matter of assumed heterodoxy arouses the whole Bench of Bishops, and renders Church literature inflammatory, and often unjust. We need scarcely allude to a recent example of this; and, while it is before us, we may not cry shame on Rome for her treatment of Galileo. Next, as to the man: he is called "the originator of true experimental philosophy," "the father of modern natural philosophy," and so on; some put him before Bacon and Descartes; some assert that he caused the downfall of Aristotelianism. Expressions and ideas of this kind become stereotyped in the human mind. They are bandied about from book to book, and from mouth to mouth; they are accepted without comment; and the full question is rarely examined and weighed. The attitude of human thought in such matters of hearsay and tradition is intensely conservative; its inertia is enormous; its condition of stability is established, and cannot easily be altered. Without doubt, Galileo ranks among the greatest natural philosophers which the world has ever seen: his discoveries are numerous and great; his influence on modern philosophy, although less than that of Bacon and Descartes, was undeniably great. A great many people, however, ignore the fact that Copernicus originated the theory of the earth's mobility, and that there were ten Copernicans in Europe in the sixteenth century, one of whom was our Gilbert, of Colchester. As regards the downfall of Scholasticism, the way had been prepared for this by such men as Aconcio, Nizolius, and Telesius. But most eminent among them all, as one who fearlessly and in the face of persecution asserted the truth and strove to break down the old barriers, was Savonarola. Free thought, and open expression of it, had been practised long before the time of Galileo. The world was ripe for the change. Galileo did not till the soil; he did not even sow the seed; but he helped to garner a mighty harvest. It is right that he should be one of the glories of science; but, to be just, we must not allow enthusiasm to distort our estimate of his chequered and not always admirable life.

First Report of the Commissioners Appointed in 1868 to Inquire into the Best Means of Preventing the Pollution of Rivers. (*Mersey and Ribble Basins.*) Vol. i. 1870.*

We have here a folio volume of some 140 pages, containing, as may be imagined, an enormous amount of condensed useful and highly interesting information. The work is divided into two main parts—viz., River Pollution (subdivided into two sections—A, Descriptive; B, Remedies) and Water Supply. The River Pollutions are classed under two heads—viz., Sewage and Manufacturing Refuse. The chemical difference between polluted and unpolluted water is clearly defined as follows:—

"Absolutely pure water is not to be found in nature. Even at the moment of its condensation in the atmosphere from invisible vapour to visible cloud, water absorbs gases, and becomes also contaminated with a fine dust which is everywhere floating in the air. When it falls to the earth as rain, it percolates through strata, or flows over surfaces more or less soluble, and dissolves, according to circumstances, quantities of solid matter varying generally from about 3 lbs. to 50 lbs. in 100,000 lbs of water. In addition to these inevitable impurities, natural and unpolluted water is not unfrequently turbid from insoluble substances suspended therein in a finely-divided condition.

"The following are the chief characteristics of unpolluted water:—It is tasteless and inodorous, possesses a neutral or faintly alkaline reaction, rarely contains in 100,000 lbs. more than $\frac{1}{2}$ lb. of carbon and 1–10th lb. of nitrogen in the form of organic matter, and is incapable of putrefaction even when kept for some time in close vessels at a summer temperature.

"Of the different kinds of pollution affecting rivers, animal organic matter, as it occurs in sewage, is that which renders water not only most offensive to the senses, but most likely to injure health, both by its gaseous emanations and by its deleterious effects when used as a beverage. Rivers so polluted frequently contain from 1 lb. to more than 2 lbs. of organic carbon, and from $\frac{1}{2}$ lb. to $\frac{3}{4}$ lb. of organic nitrogen, in 100,000 lbs. Pollution by vegetable organic matter, such as that caused by dye and print-works, stands next as regards offensiveness; water so polluted being excessively unpleasant, not only to the sight, but also, in warm weather, to the sense of smell. It often contains, in 100,000 lbs., twice as much organic carbon as is present in water polluted by sewage, but, owing to the comparatively small proportion of nitrogen in vegetable substances, it rarely contains more than one-third of a pound of organic nitrogen. Chemical works contribute chiefly mineral impurities, which often communicate to water extreme hardness and other disagreeable and even poisonous properties."

The following is a brief summary of the chemical researches instituted:—

"(*a.*) The total amount of solid matters present *in solution*:—The most important constituents of these solid matters are—

"1. Organic carbon.

"2. Organic nitrogen.

"3. Ammonia in the form, chiefly, of carbonate of ammonia.

"4. Nitrogen in the form of salts of nitric acid and nitrous acid.

"5. Total combined nitrogen—This determination sums up the whole of the analytical evidence against the water, as regards both past and present organic contamination.

"6. Chlorine. The proportion of chlorine in water may often be used as an indication of the extent to which a stream has been contaminated with *sewage*, as distinguished from *solid* animal matters. The chlorine in river water is almost always combined with sodium as common salt, which is a large and essential constituent of urine, and consequently of sewage, whilst it is present in only comparatively minute

* The Commissioners are Dr. Frankland, F.R.S., Sir William Denison, F.R.S., and Mr. J. C. Morton.

quantity in solid manure. It is scarcely necessary to say, however, that the determination becomes valueless for this purpose in the neighbourhood of the sea and of natural deposits of salt—such as that existing in the Valley of the Weaver, for instance. The normal proportion of chlorine, as common salt, existing in this country in waters which have never been polluted by excrementitious matters, is about 1 part in 100,000 of water. Most of this is probably carried from the ocean to the land through the air as sea-spray or fine particles of salt; for we find that the unpolluted waters of an inland country like Switzerland contain only about 0·2 part of chlorine in 100,000 parts.

"7. Hardening constituents.

"(*b*) The total amount of solid matters *in suspension*:—In this it is very important to distinguish between organic and mineral matters. We have therefore determined—

"1. The organic matters in suspension.

"2. The mineral matters in suspension."

The alleged self-purification of polluted rivers, a subject of paramount importance, is treated of in the following terms:—

"At the time the winter samples were taken, the rivers were not in a state of putrefaction; any purification which they underwent during their progress towards the sea was, therefore, produced at this time either by the oxidation of the polluting organic matter contained in the solution, or by the subsidence of the suspended matters. It has often been stated, but, so far as we know, without any proof, that the organic matter contained in sewage and other similar polluting materials is rapidly oxidised during the flow of a river into which such materials are discharged. Thus, it has been asserted ("Report of Royal Commission on Water Supply," p. 79), that if sewage be mixed with twenty times its volume of river water, the organic matter which it contains will be oxidised and completely disappear whilst the river is flowing 'a dozen miles or so.' We thought it very undesirable that a subject of such vital importance to our inquiry should any longer rest upon mere opinion, and we therefore determined to submit it to careful experimental investigation. During our winter visit to the basins of the Mersey and Ribble, a very favourable opportunity presented itself for the solution of this important problem. The river Mersey, after receiving the drainage of many towns and manufactories above the Stretford Road Bridge, flows thence 13 miles, to its junction with the Irwell, without encountering any other material source of impurity, although its volume is somewhat augmented by unpolluted affluents. The river Irwell, after passing Manchester, falls over a weir at Throstlenest, and runs 11 miles, to its junction with the Mersey, without further material pollution, and with but very unimportant unpolluted affluents. Lastly, the river Darwen, which is greatly polluted by the sewage of Over Darwen, Lower Darwen, and Blackburn, joins the Blakewater just below the latter town, and then flows 13 miles, to near its junction with the Ribble at Walton-le-Dale, without any further pollution, although its volume becomes more than doubled in this part of its course by the accession of the river Roddlesworth, the Alum-House brook, and numerous small affluents, all of which are unpolluted.

"We took samples of water at the top and bottom of the courses of these rivers at the places just indicated, viz.—1. The Mersey at Stretford Road Bridge, and again just before its junction with the Irwell. 2. The Irwell, as it fell over the weir at Throstlenest, and again just before its junction with the Mersey; similar samples of this river being also taken in May and June following. 3. The Darwen, one-third of a mile below its junction with the Blakewater, and again 50 yards above the bridge at Walton-le-Dale."

The main result of these experiments is summarised in the following words:—

"It is thus evident that, so far from sewage mixed with 20 times its volume of water being oxidised during a flow of 10 or 12 miles, scarcely two-thirds of it would be so destroyed in a flow of 168 miles, at the rate of 1 mile per hour, or after the lapse of a week. But even this result is arrived at by a series of assumptions which are all greatly in favour of the efficiency of the oxidising process. Thus, for instance, it is assumed that the 62·3 per cent of sewage is thoroughly oxidised and converted into inoffensive inorganic matter; but the experiments showed that, in fact, no sewage whatever was so converted or destroyed, even after the lapse of a week, since the amount of carbonic acid dissolved in the water remained constant during the whole period of the experiment; whilst, if the sewage had been converted into inorganic compounds, the carbonic acid, as one of these compounds, must have increased in quantity.

"Thus, whether we examine the organic pollution of a river at different points of its flow, or the rate of disappearance of the organic matter of sewage when the latter is mixed with fresh water and violently agitated in contact with air, or, finally, the rate at which dissolved oxygen disappears in water polluted with 5 per cent of sewage, we are led, in each case, to the inevitable conclusion that the oxidation of the organic matter in sewage proceeds with extreme slowness, even when the sewage is mixed with a large volume of unpolluted water, and that it is impossible to say how far such water must flow before the sewage matter becomes thoroughly oxidised. It will be safe to infer, however, from the above results, that there is no river in the United Kingdom long enough to effect the destruction of sewage by oxidation."

This is confirmed by the evidence given by Sir B. Brodie, before the former Rivers Pollution Commission, in the following words:—

"I should say that it is simply impossible that the oxidising power acting on sewage running in mixture with water over a distance of any length is sufficient to remove its noxious quality. Taking the case of Oxford: if the sewage of Oxford was, in its entirety, discharged into the river Thames, I should say that we could certainly not trust to the oxidising power to take away the noxious quality of the water before it reaches, say, Teddington. I presume that the sewage could only come in contact with oxygen from the oxygen contained in the water, and also from the oxygen on the surface of the water; and we are aware that ordinary oxygen does not exercise any rapidly-oxidising power on organic matter. I believe that an infinitesimally-small quantity of decayed matter is able to produce an injurious effect upon health; therefore, if a large proportion of organic matter was removed by the process of oxidation, the quantity left might be quite sufficient to be injurious to health. With regard to the oxidation, we know that, to destroy organic matter, the most powerful oxidising agents are required; we must boil it with nitric acid and chloric acid and the most perfect chemical agents. To think to get rid of organic matter by exposure to the air for a short time is absurd."

While pollution of rivers by sewage is a more ordinary feature of their contamination, we need not refer here to this point any further, but prefer to lay before our readers some curious facts in relation to pollution by manufacturing refuse, alluded to in general terms in the following words:—

"The operations carried on in bleaching, dyeing, and printing calicoes involve the pollution of large volumes of water, partly by mineral, but chiefly by organic matters. In most cases, the colouring matters, which it is the object of the manufacturer to fix upon the tissues, are contained in but very small proportion in the dye-stuffs employed; thus the weight of actual colouring matter in 1 ton of madder is not more than $2\frac{1}{4}$ lbs.; hence, nearly the whole of these dye-stuffs is refuse matter, which, partly in solution, and partly in the solid condition, is carried by the gait of the mill into the adjacent stream. According to Mr. Robert Hammond (Messrs. Bradshaw, Hammond, and Co.), Reddish Vale Print-works, near Stockport, who has kindly made some careful experiments for us on this point, only 25 per cent of the madder used for dyeing goes into the stream in a state of suspension; the remainder, being rendered soluble in the processes of dyeing and garancine making, consequently enters the stream in solution; hence the large proportion of

organic carbon and organic nitrogen in solution in the effluent water. Mr. Hammond states that 100 tons of ground Turkey madder-root leave, after being used for dyeing, 48½ tons of dry spent madder; this, when made into garancine in the usual manner, and afterwards used for dyeing, leaves 25 tons of dry spent garancine. The returns show that this spent garancine is habitually put into the river or goit. With the exception of a small proportion of the mordants, and of the starch which is used in stiffening the finished goods, all the remaining chemicals find their way into the stream, since they are used in scouring, washing, and cleansing, and are not contained in the goods sent out of the factory. We may gain some idea of the extent of the pollution arising from the processes in question by considering the annual consumption of dye-stuffs, chemicals, and other materials, in one such factory of about average size. The Kinder Printing Company, at Hayfield, Derbyshire, have their works situated on the Kinder brook, a tributary of the Goyt; they employ 250 hands, and use annually—

Madder	200 to 250 tons.
Peachwood	38 tons.
Logwood	260 "
Sumach	79 "
Sulphuric and muriatic acids	100 to 125 tons.
Soda-ash	50 tons.
Bleaching powder	14 "
Lime about	30 "
Soap	44 "
Liquid arseniate of soda, containing 833·2 lbs. of metallic arsenic	19 "
Cow's dung	157 "
Starch	49 "
British gum	19 "

"The quantity of polluted water sent out from these works is estimated at 500,000,000 gallons per annum. It is passed through a series of small settling tanks, and then strained through canvas, to intercept the coarser particles of madder, which are either converted into garaneux and re-used for dyeing, or (exceptionally in these works) put upon land, or burnt. After passing the canvas strainer, the polluted water traverses rapidly a serpentine canal 258 yards in length, and then falls into a culvert, which conveys it below the next printworks on the stream, the works of the Hayfield Printing Company."

The result of the analytical researches made on this subject by the Commissioners show that the prominent character of this form of pollution is like that of sewage organic matter; but the organic matter of dye-water is much less highly nitrogenised than that of sewage, and is therefore, presumably, less putrescible, and, consequently, less offensive. Amongst the mineral polluting materials "of calico-printworks, arseniate of soda alone demands especial notice. About fifteen years ago, it was discovered that arseniate of soda increased both the economy and efficiency of the dung-bath, and a mixture of cow's dung and arseniate of soda appears to have now to a great extent superseded the older mixtures in this part of the calico-printing process. Arseniate of soda (a compound of arsenic acid and soda, containing from 30 to 33 per cent of metallic arsenic) is excessively poisonous; and it is fortunate that the amount required in the calico-printing process is but small when compared with the vast volume of water with which it is mixed. Nevertheless, analysis reveals a very appreciable proportion of arsenic in the effluent water from printworks. Thus, the polluted water flowing from the Kinder Printing Company's works contains, in 100,000 lbs., 0·032 lb. of metallic arsenic, equivalent to 0.042 lb. of arsenious acid or white arsenic. Although this proportion is so small that it would be necessary for an individual to drink no less than 138 gallons of the water in order to imbibe a fatal dose, yet it cannot but be considered undesirable that our rivers should thus become contaminated with such a poisonous ingredient."

The pollution by chemical works is described in the following manner:—

"The chief chemical works carried on in the basins of the Mersey and Ribble are devoted to the manufacture of soda alkali, soap, colours, and oxalic acid. The waste products are alkali waste, dilute muriatic acid (containing a considerable proportion of arsenic), burnt pyrites, chloride of manganese (containing arsenic), and chloride of calcium.

"The alkali waste is not thrown into the neighbouring river or stream, but it is stacked in enormous heaps, from which there drains a liquid containing much sulphuret of calcium in solution, and possessing an odour like that of putrid eggs.

"The burnt pyrites was formerly got rid of as rubbish, but it is now utilised, having been found to be of value as a source of copper.

"The dilute muriatic acid is, as a rule, run into the nearest stream or canal. Messrs. Crossfield, Brothers, and Co., return, as the amount of weak muriatic acid thus run away, 500,000 gallons annually (sp. gr., 1·005), which would contain about 1 per cent of real acid. Mr. A. E. Fletcher, one of the sub-inspectors under the Alkali Act, estimates the amount of free acid thus annually run to waste in the United Kingdom at 111,400 tons of real acid, or 371,133 tons of commercial liquid muriatic acid of 30 per cent strength. This is 45·5 per cent of the total quantity made.

"The chloride of manganese, though containing a valuable material, has not hitherto been utilised to any appreciable extent, and is consequently discharged into the nearest stream. Mr. Fletcher informs us that 54,000 tons of black oxide of manganese are annually consumed in the United Kingdom. Nearly the whole of this finds its way into the rivers as chloride of manganese, 57,500 tons of real muriatic acid being partly combined and partly mixed with it. According to the return of Messrs. Crossfield, Brothers, and Co., whose works are situated on the Sankey Canal, at St. Helen's, a single alkali work thus turns out, annually, as much as 1060 tons of manganese in the condition of chloride.

"The solution of sulphuret of calcium draining from the heaps of alkali waste meets, in the adjacent river, with the two waste products just mentioned, and undergoes, in contact with the dilute muriatic acid and acid chloride of manganese, a very unpleasant reaction, in which large quantities of sulphuretted hydrogen are given off into the surrounding atmosphere; some sulphur and sulphuret of arsenic are thrown into suspension as a fine mud, and the solution of sulphuret of calcium is transformed into a comparatively innocuous one of chloride of calcium. The chloride of manganese also remains in solution, and the stream continues strongly acid.

"The worst case of river pollution from alkali works that we have met with occurs in the Sankey Brook, which receives the waste products from the St. Helen's alkali works. Between St. Helen's and Warrington, the exceedingly offensive smell of this brook can be perceived at a distance of from one to two miles from its banks. When the wind blows from the west, it always unpleasantly surprises the passengers on the London and North-Western Railway between Warrington and Kenyon Junction. Leaving injury to health out of the question, it is no exaggeration to say that this brook renders the country within two miles of its banks uninhabitable, except under a penalty of so much discomfort as few would be prevailed upon to endure."

"The results of the analysis of the pollutions from alkali works are almost entirely of a mineral character, with much free acid, and, curiously enough, free sulphur, for we read—

"A sample of the mud taken from the Sankey Brook, just before its junction with the Sankey Canal, contained, when dried at 100° C., 22·75 per cent of free sulphur. A sample of sludge that had been recently dredged from the Sankey Canal, near its junction with the Sankey Brook, contained 3·97 per cent of free sulphur after drying at 100° C. When it is remembered that sulphur is worth from £6 to £7 per ton, and that 100 tons of the dried mud of the Sankey Brook contain 22¾ tons, and that nearly as much passes into the

air as sulphuretted hydrogen. some conception may be formed of the vast quantity of valuable, and, as we shall presently show, recoverable material, which is thus thrown away and suffered to pollute both air and water to an intolerable degree."

It is quite impossible that, with the enormous mass of interesting details laid before us in this volume, we should be enabled to give here an exhaustive review; we cannot refrain, however, from noticing one of the curious consequences of the introduction of the use of pyrites instead of sulphur for the manufacture of sulphuric acid—

"Thus sulphur has been gradually, but at length completely, replaced by iron pyrites in the production of sulphuric acid for the alkali manufacture. Unfortunately, however, iron pyrites nearly always contains a notable quantity of arsenic, much of which passes into the sulphuric acid obtained from this material. Dr. R. Angus Smith, Your Majesty's Inspector of Alkali Works, informs us (Vol. II., 'Minutes of Evidence,' part 4), that 400,000 tons of iron pyrites are annually imported into this country for the alkali trade. At a moderate computation, we thus annually import 1600 tons of arsenic, a large proportion of which, there is every reason to believe, now finds its way into our rivers and streams. In the alkali factory, the sulphuric acid is employed to decompose chloride of sodium in a closed furnace. The arsenic is here transformed into chloride of arsenic, which, being volatile, passes off, to a great extent, with muriatic acid gas to the condensing towers, where it is dissolved by water and becomes a constituent of strong liquid muriatic acid, which is afterwards used in the manufacture of bleaching powder; and also of weak muriatic acid, which, as we have already described, is run directly into the nearest watercourse. The disposal, in like manner, of the arsenic in the strong muriatic acid is only postponed; it ultimately finds its way into the rivers as waste chloride of manganese liquor. But to return to the non-volatile product of the action of sulphuric acid upon chloride of sodium, technically called 'salt-cake,' which still retains a certain small proportion of the arsenic originally present in the sulphuric acid. This salt-cake is afterwards mixed with crushed chalk, or limestone and coal-dust; and the mixture is heated to incipient fusion in a reverberatory furnace. Here some of the arsenic must volatilise—indeed it might be expected that the whole of it would do so, did not the sequel prove this not to be the case; moreover, the coal-dust, which also contains arsenic, probably more than compensates for the loss. The product of this operation is termed 'black-ash.' It is afterwards lixiviated with water, and the lixivium, being evaporated to dryness, yields soda-ash. In some factories, the crystalline granules of soda-ash, as they are deposited during evaporation, are fished out of the boiling liquor, and are afterwards sent into the market as ash of first quality. The residual liquor being evaporated to dryness constitutes ash of the lowest quality, which will contain the largest proportion of arsenic, whilst the first quality ash may be comparatively or entirely free from the poison. In a series of samples kindly supplied to us from a large chemical work, we have clearly traced the arsenic from the original iron pyrites, through the different products just enumerated, up to this point. A certain proportion of soda-ash is re-dissolved in water, and then allowed slowly to crystallise; the soda crystals thus obtained are a true carbonate of soda, and constitute the common 'washing soda' of the shops. We have examined nine samples of washing soda obtained from as many oil shops, and found that only two of them contained the poisonous metal. The bicarbonate of soda, again, of the druggist is made from the soda crystals just mentioned. Two samples of this material were examined and found to be entirely free from arsenic.

"Soda-ash is extensively used in all bleaching and scouring operations; and thus arsenic is unconsciously introduced into a vast number of factories, as, for instance, that of Messrs. Bright and Co., at Rochdale. It is employed in the manufacture of soap, but is for the most part got rid of in the spent lye of soap works, a specimen of which contained 0·325 part of arsenic in 100,000 parts; hence, of six samples of soap which we have examined, only two contained arsenic, and in but very minute quantity. As soap and washing soda are used in most households, the poisonous metal is liable to gain admission into many dwellings; it is carried by the slops into the sewers, and, in London, is afterwards found in the sewage at Barking to the extent of 0·004 in 100,000 parts.

"We are by no means disposed to take an alarmist view of this wide distribution of arsenic amongst the community; indeed, as we find it to be contained in very appreciable quantity in the rain which falls in London, being derived in this case from coal smoke, it is, doubtless, present in the rain-water of all our large towns, and consequently cannot be entirely excluded from rivers; nevertheless, its unnecessary introduction cannot but be regarded as, on many grounds, undesirable; and we believe that, so far as soda-ash and its derivatives are concerned, it might be easily prevented by submitting the 'salt-cake' and 'black-ash' to a somewhat more prolonged roasting, by which the arsenic, now partially driven off, would be completely expelled. We trust that, when the presence of this impurity becomes known to alkali manufacturers, they will direct their attention to remedy the evil, introduced into their processes chiefly by the substitution of iron pyrites for sulphur."

Turning our attention now to the remedies proposed, we find the following in respect of the purification of sewage, treated under the three heads of—Treatment with Chemicals; Filtration; and Irrigation. The first of these is alluded to as follows:—

"*Purification of Sewage by Chemical Agents.*—The valuable constituents of sewage present to the chemist a mine of wealth, which, despite so many failures, has constantly stimulated him to renewed efforts for their extraction in a portable, and consequently marketable, form.

"The chief valuable ingredients of sewage are, first, the different forms of combined nitrogen; and, second, phosphoric acid. The money-value of these constituents *dissolved* in 100 tons of average sewage is about 15s., whilst the *suspended matters* contain only about 2s. worth of them.

"There is but little difficulty in extracting the suspended matters by filtration, but, as these do not contain quite one-seventh of the total valuable constituents, the process, though simple, has never been remunerative; and, inasmuch as it still leaves much putrescible organic matter in solution, the mere extraction of the suspended matters of sewage, although doubtless tending to mitigate nuisance, does not produce any substantial diminution of the polluting quality of the liquid. The operations of the chemist have therefore been directed chiefly to the soluble constituents of sewage; and have had for their object, either the precipitation in a solid form of the valuable, but offensive, ingredients, so as to convert them into portable manure, or, secondly, the rendering them inoffensive by the action of disinfectants. Although these operations have not been altogether unsuccessful, they have hitherto entirely failed in purifying average sewage to such an extent as to render it admissible into running water. We have formed this opinion both from observations of the polluting effect of such chemically-purified sewage upon the streams into which it was admitted, and from the amount of putrescible organic matter revealed by the chemical analysis of the sewage after treatment.

"The following is a description of those processes belonging to the chemical category which we have witnessed in operation:—

"(*a*). *Treatment with Lime.*—This process was doubtless first suggested by the ingenious operation devised by the late Dr. Clarke, of Aberdeen, for softening certain hard waters. It has been applied to sewage upon an extensive scale, at Tottenham, for the manufacture of 'Tottenham sewage guano;' at Blackburn, and especially at Leicester, in the production of the so-called 'Leicester bricks' (the name under which the manure was sold). In all these

places, the plan has been a conspicuous failure, whether as regards the manufacture of valuable manure, or the purification of the offensive liquid.

"We have witnessed the process at Blackburn, and on two occasions at Leicester, where it is still used, the machinery employed at the latter place being very perfect and efficient.

"At both places the method obviously failed in the purification of the sewage to such an extent as to render it admissible into a river. At Blackburn especially the river below the outlet of the limed sewage was in a most offensive condition of putrefaction, our note made at the time of our visit being as follows:—'Horribly offensive, turbid, blackish stream, disengaging most offensive gases, with black masses of putrid mud floating on the surface.'

"The operation is exceedingly simple, and, as carried out at Leicester, consists in mixing with the sewage, as it arrives at the works, a certain proportion of milk of lime. The mixture is then violently agitated by appropriate machinery on its way to large reservoirs of subsidence, in which a copious deposit of highly-putrescible mud takes place, whilst the supernatant liquid flows off in a comparatively clear, though still somewhat milky, condition. The floors of the reservoirs of subsidence slope from two opposite sides towards the centre, where there is a gutter, from which a Jacob's-ladder elevates the slush into a shoot, through which it is conveyed to pits, where it slowly dries, partly by evaporation and partly by soakage into the surrounding soil.

"(*b*). *Treatment by Sillar's Patent or "A.B.C." Process.*—The specification of this process is given by the patentees, Messrs. W. C. and R. G. Sillar and W. G. Wigner, as follows:—

"'We add to the sewage to be purified a mixture consisting of the following ingredients:—Alum; blood; clay; magnesia or one of its compounds (by preference the carbonate or the sulphate); manganate of potash or other compound of manganese; burnt clay, otherwise known as ballast; chloride of sodium; animal charcoal; vegetable charcoal; and magnesian limestone. Of these substances, the manganese compound, the burnt clay, chloride of sodium, and magnesian limestone may be omitted; and it is not essential that both animal and vegetable charcoal should be used. If any of the ingredients named should from any cause be present in sufficient quantity in the sewage, it may of course be omitted from the mixture. The proportions in which the ingredients are to be used vary according to the nature of the sewage to be purified—as, for instance, if a large proportion of urine is present, we increase the proportion of clay; if the sewage is much diluted, we slightly increase the proportion of alum and blood; if it contains a large proportion of street-refuse, we decrease the proportion of clay.

"'For ordinary sewage, the following proportions have answered well:—

Alum	600	parts
Blood	1	"
Clay	1900	"
Magnesia	5	"
Manganate of potash	10	"
Burnt clay	25	"
Chloride of sodium	10	"
Animal charcoal	15	"
Vegetable charcoal	20	"
Magnesian limestone	2	"

"'These substances are mixed together, and added to the sewage to be purified until a further addition produces no further precipitate. The quantity required will be about 4 lbs. of the mixture to 1000 gallons of sewage. In many cases, it is preferable to mix the above compound with a small quantity of water, and add it in a liquid state to the sewage. The sewage must then be thoroughly mixed with the compound, and allowed to flow into settling-tanks. The greater part of the organic and other impurities will be immediately separated in the form of large flakes, which rapidly fall to the bottom, leaving the supernatant water clear and inodorous, or nearly so. The water may then be allowed to flow away into a river, or be disposed of in any other way, and the sediment or mud allowed to accumulate at the bottom of the tank. In some cases, it is preferable to add the compound of manganese to the water after the sediment produced by the other ingredients has been allowed to subside. The sediment will be found to possess the power of precipitating a further quantity of sewage; it must therefore be pumped or otherwise taken from the tank, and mixed with fresh sewage, the sediment being allowed to subside in the same way as before. The sediment may be used five or six times over in this way. When the sediment no longer possesses the power of precipitating the impurities in the sewage, it must be removed from the tank, and allowed to dry. When partially dry, a small quantity of acid (by preference sulphuric acid) may be mixed with it, which will retain all the ammonia in a soluble form. When dried, the sediment will be a valuable manure.'"

Speaking of this process the Commissioners say that, "Notwithstanding the loss of nitrogenous organic matter in the process of deodorisation, the 'A.B.C.' method of treatment still yields a solid manure of much greater value than that obtained by the lime process—a circumstance which is explained, to a great extent, by the acidity of the mud from the former process, and the alkalinity of that from the latter. The lime mud thus loses ammonia in drying, whilst the other, especially if still further acidified, cannot suffer this loss."

The analysis of the mud shows that "In the three valuable constituents of manure, viz., in ammonia, in other forms of combined nitrogen, and in phosphoric acid, the manure obtained by Sillar's process is greatly superior to that resulting from the treatment with lime. Unfortunately, some doubt is thrown upon the source of the increased amount of phosphoric acid present in the manure obtained by the former process, because bone-black, in, to us, unknown quantity, entered into the composition of the precipitating material used, and thus an uncertain amount of phosphoric acid was added to that which was actually derived from the sewage."

The results of their experiments on the Sillar and lime processes are summarised as follows:—

"1. The 'Sillar' and lime processes remove to a great and nearly equal extent the suspended matters contained in sewage.

"2. Sillar's process increases the amount of dissolved solid matters in sewage, but reduces the quantity of putrescible organic matter. The lime process reduces both the amount of dissolved solid substances and the quantity of putrescible organic matter; the reduction of the last being about the same as that effected by Sillar's process, viz., rather more than one-half.

"3. Both processes fail in purifying sewage to such an extent as to render it admissible into running water."

"4. For the manufacture of solid manure from sewage, Sillar's process is greatly superior to the method of treatment by lime, although it fails to extract from the liquid more than a very small fraction of its valuable constituents."

The treatment by lime and chloride of iron is described as follows:—

"At Northampton, this process is applied to the sewage of 40,000 people. 4400 houses are here connected with the drains, and 2800 are undrained. The excellent and constant water supply of 600,000 gallons daily, or 15 gallons per head, is derived chiefly from deep wells in the oolite. The sewage works are situated about half a mile from the town. Each million gallons of sewage is here mixed with 12 bushels of lime and about 6 gallons of chloride of iron (in hot weather more; in cold weather less). The lime is added first, and then the chloride of iron. The defecated sewage is afterwards submitted to upward filtration through a stratum of calcined iron-ore 8 inches thick; but we consider that, beyond the separation of suspended matters, which would be equally effected by subsidence, this latter operation is nearly useless. The effluent sewage, after a flow of 1½ miles

through a culvert, in which it becomes mixed with about one-sixth of its volume of spring water, is discharged into the river Nen, in a nearly clear and apparently innocuous condition. We examined the stream for about one-third of a mile below the outfall, and could perceive no sewer-fungus or other sign of sewage pollution. Nevertheless, analysis shows that the sewage discharged into the stream still contains in solution a large amount of putrescible organic matter; but the putrescence of this matter was doubtless delayed, by the chloride of iron used in the treatment, until the stream had flowed beyond the point where we examined it. It is well known that chloride of iron possesses this property in a very remarkable degree;* but the putrefaction of the disinfected sewage is only delayed, and not ultimately prevented. In fact, the river Nen does eventually become putrid in consequence of the discharge into it of the Northampton sewage; and an injunction has been granted by the Court of Chancery restraining the Improvement Commissioners from discharging the sewage of the town into the river after June 1st, 1870.

"The chloride of iron in solution is manufactured on the premises at a cost of £6 per ton. A sample of it which we brought away with us contained, in 100,000 parts:—

Iron as perchloride	4413·7
" protochloride	9124·3
Total iron	13538·0

"*Treatment with Crude Sulphate of Alumina, and subsequent Filtration through Coke.*—This process, which is known as Bird's, is carried out at Stroud, in Gloucestershire. From 150 000 to 200,000 gallons of sewage are daily treated with 6 cwts. of pulverised clay, to which 120 lbs. of sulphuric acid have been added some days previously. The sewage is made to turn a small water-wheel which regulates the delivery from a hopper of the sulphated clay or crude sulphate of alumina, which falls into the stream of sewage on its passage to a settling-tank, whence it flows under a second hopper, from which it receives a second dose of the sulphated clay. Thence it flows into a depositing-tank, and afterwards through three coke filters. The coke is renewed in the first filter every fortnight, and in the last every month. The foul coke is burnt under the boiler."

The condensed results of purification of sewage are expressed, as far as chemical processes are concerned, in the following brief tabulated form:—

Chemical processes.	Average percentage of dissolved organic pollution removed. Organic carbon.	Organic nitrogen.	Average percentage of suspended organic pollution removed.
Best result	50·1	65·8	100·0
Worst result	3·4	—	59·6
Average result	28·4	36·6	89·8

The sections on the purification of rivers from the liquid refuse from manufactories, and that on water-supply, however interesting, are of too local an interest, in this instance, to call for condensation or for an abbreviated account here. The recommendations of the Commissioners are worthy of our notice, and we therefore quote these in full, with the observation, however, that nobody acquainted with what is really meant by, and included in, the term *police*, taken in the scientific sense, can fail to see that the want of sufficient centralisation and power of control given to the Secretary of State for the Home Department, as *ministre de l'intérieur* over all municipal and local authorities, where and whatsoever they be, is at the bottom of the state of matters, caused by ignorant neglect, as well as foul selfishness, and described in these pages. What is absolutely wanted is a strongly and well organised *administration de la sûreté et de la salubrité publique*. As understood and carried out abroad, *Salus populi suprema lex esto*.

"1. That the casting of any solid matters, of whatever kind, into rivers and running waters, or the placing of solid refuse in such positions on the banks of rivers as to render it liable to be washed away by floods, be absolutely prohibited under adequate penalties; and that any act passed for this purpose be made to take effect immediately.

"2. That the discharge of any polluting liquids, such as those defined in the conclusions to this Report, into any river or stream, from any sewer or other outlet, reservoir, tank, or vat, be prohibited under adequate penalties; but that, after the passing of any act prohibiting the admission of polluting liquids into running water, a reasonable time be allowed to corporations, local boards, manufacturers, and others, for the execution of the necessary works for purification.

"3. That all rivers and streams in England be placed under the superintendence of a central authority or board, to be composed of not more than three persons, who shall be duly qualified to deal with all questions connected with the pollution of water and with water-supply..

"4. That it be the duty of this board to see that all enactments relating to the use or abuse of running water be duly enforced; and that, for this purpose, power be given to it to inspect manufactories, reservoirs, sewerage, and other similar works, and to cause to be constructed, at the expense of the owners of the same, whether corporate or private, any necessary purifying-apparatus, in case the said owners neglect or refuse to provide such apparatus for themselves.

"5. That, subject to proper regulations to prevent abuse, additional powers be given to corporations, local boards, manufacturers, and others, to take land compulsorily, under 'Provisional Order,' for the purpose of cleansing sewage or other foul liquids, either by irrigation, filtration, or otherwise, and to obtain, if required, easements for the construction of culverts and outfalls for drainage through private property, making compensation only for damage actually done, reserving, however, to the owner the right at any time afterwards, if he could show further damage, to have further compensation.

"6. That it be the duty of the central board to exercise a surveillance over both the quality and quantity of the water-supply of towns; to carefully guard domestic supply from contamination, or, if it be already contaminated, to ascertain the source or sources of injury, and to cause the same to be removed.

"7. That it be the duty of this central board to investigate all schemes for water-supply; and also all proposals for public works connected with river-conservancy, whether initiated by local authorities or by any principal conservancy board of a river-basin either now in existence or to be hereafter constituted; and to report thereon to one of Your Majesty's Principal Secretaries of State."

Our space forbids us to make further extracts from this full and comprehensive report, but we cordially recommend its perusal to all interested in the question. As stated in the prefatory remarks, the report refers to the subject of river conservancy generally as well as to the condition of the particular river basins to which it is professedly confined. The Commission could not have included a more able and earnest worker than Dr. Frankland, and our thanks are due to him and his brother Commissioners, Sir W. J. Denison and Mr. J. C. Morton, for the great scientific skill they have brought to bear on this difficult subject.

Proceedings of the American Pharmaceutical Association at the Seventeenth Annual Meeting, held in Chicago, Ill., September, 1869 Philadelphia. 1869.

This well got up volume, containing nearly 500 pages, is a most convincing proof of the flourishing, and, at the same time, highly scientific and efficient, *status* of the pharmaceutical branch of the medical profession in the United States, and the confirmation, also, of the truth of the "E Pluribus Unum," in another and not less highly creditable sense.

* Report on the Deodorisation of Sewage, by Hofmann and Frankland, presented to the Metropolitan Board of Works, August 12th, 1859.

Since it is entirely out of the question to give more than a very superficial account of the contents of this work, we quote from the contents the following particulars:—As might be expected from the title, a very full account is given of the meetings held during six sittings. Next follow Reports of Committees; that of the Committee on the Progress of Pharmacy being, indeed, a masterpiece of its kind, including as it does pharmacognosy, pharmaceutical chemistry, and pharmaceutical legislation. We next meet an excellent report of the Committee of Specimens, followed by a Report on the Pharmacopœia. Among the special reports, we notice those on Pharmaceutical Glass-Ware, and on Corks (this is a very interesting paper, full of generally-useful information). Among the volunteer reports and essays, we notice the United States Cabinet of Practical Geology and Mining; while we regret that we cannot enter into particulars we must not omit to call attention to the short paragraph on this subject in our issue of February 18th last (Chemical News, vol. xxi., p. 83; *Am. Repr., April*, '70, *page* 218) Under the title of "The St. Louis Medical Spring," by Samuel S. Garrigues, we meet with the following analysis of a mineral water accidentally discovered at a depth of 200 feet below the surface, while borings were made for finding salt at St. Louis, Gratiot Co., Mich.:—Temperature of water, 50° F.; constant sp. gr., 1·011. Total mineral matter in a gallon, in grains, 270·60, viz.,—Sulphate of lime, 66·50; silicate of lime, 6·72; chlorine (curiously enough) only a trace; bicarbonate of soda, 106·40; bicarbonate of lime, 69·40; bicarbonate of magnesia, 17·50; bicarbonate of iron, 1·20; free silica, 2·88; organic matter and loss, 2·00;—total constituents, 272·60; free carbonic acid in gallon, 6·21 (*qu*eritur, what—grains or cubic inches?). This water is stated to carry a current of electricity, or, perhaps, magnetism (time did not allow to specify which). Under the heading of "Michigan Salt," by the same author, we meet with the two following analyses of samples of Saginaw salts, percentically and respectively composed of—Chloride of sodium, 93·892 and 95·327; chloride of calcium, 1·446 and 0·699; chloride of magnesium, 0·771 and 0·313; moisture, 3·430 and 3·308; sulphate of lime, 0·461 and 0·363. It need hardly be said that the volume before us contains a large amount of highly-interesting well-digested and collected information in regard to pharmacy in all its relations, but space forbids us to enter into further details.

CORRESPONDENCE.

Action of Iodine on Hyposulphite.

To the Editor of the Chemical News.

Sir,—In reply to the letter of Mr. E. Sherer in the Chemical News (vol. xxi., p. 141; *Am. Repr., May*, '70, *page* 273) I have to say that my experiments on the action of iodine and hyposulphite solutions were performed immediately after his paper, "On the Estimation of Manganese Ores," was read before the Newcastle Chemical Society (Nov. 25th, 1869), and were sent to that Society before the appearance of his further note on the subject in the Chemical News (vol xxi., p 48; *Am. Repr., March*, '70, *page* 176). His statement that the increased amount of iodine formed on allowing the liquid obtained in Bunsen's process to stand some hours "was caused by the conversion of iodine into hydriodic acid" (*sic*), did not appear in the original paper read in Newcastle.—I am, &c.,

G. R. A. Wright.

Washington Chemical Works, Durham,
April 2, 1870.

Manufacture of Sulphuric Acid.

To the Editor of the Chemical News.

Sir,—I was just going to answer the objections which Mr Gibbins made, in the Chemical News (vol. xxi., p. 132; *Am. Repr., May*, '70, *page* 292), to my proposed improvement in the manufacture of sulphuric acid, when I saw the letter of Mr. P. Spence, stating that he has already tried, in his large chemical works, some experiments on the subject. Mr. P. Spence answering, in every respect to my full satisfaction, the objections of Mr. Gibbins, I have only few words to add.

For the last three years, a great number of vitriol chambers here work at a high specific gravity; but they are arranged different from those of Mr. Spence. The sulphurous acid comes in contact with the nitric acid in a little chamber of a capacity of scarcely 100 cubic metres (called in France, *tambour*); it is in this chamber that the action of the two acids takes place. No aqueous vapour, or very little, is introduced in this chamber, and the vitriol manufactured is kept at a specific gravity of 1·715. When this chamber is first set at work, there is no doubt that a layer of sulphate of lead is formed; but, as no aqueous vapour is introduced, it remains on the lead, and protects it against a further action. I have cut out a piece of lead of 10 c.c. after a trial of three years, and I found that it weighed as much as an equal piece of lead of a chamber which, during the same lapse of time, worked otherwise than by my system.

Mr. Gibbins is quite right in saying that the vitriol manufactured under these circumstances is so charged with nitrous acid that, on concentration, a great loss of nitric acid is caused; but, as Mr. P. Spence explains very well, this acid is not employed directly, but is run into a series of different chambers, where it loses so completely all nitric acid, by the action of sulphurous acid, that the vitriol which is run off no longer gives a colouration on addition of sulphate of iron.—I am, &c.,

P. W. Hofmann.

Société Anonyme des Anciennes Salines
Domaniales de l'Est.
Establissements de Dieuze (Meurthe),
April 4th, 1870.

Manufacture of Sulphuric Acid.

To the Editor of the Chemical News.

Sir,—I think it due to Mr. Hofmann, while acknowledging him as the originator of what I expect will become an immense improvement in the manufacture of sulphuric acid, and expressing my thanks for his liberality in freely giving his invention to the chemical world, to give him, and all who feel interested in the matter, my experience in working out Mr. Hofmann's plan with what I still consider my slight improvements in the *modus operandi*.

I am under the necessity of keeping all my chambers at work while gradually making my arrangements for the new mode, as I require the equivalent of 90 to 100 tons of acid of 1·845 out of them weekly; I am, therefore, only partially at work on the new plan, but so far with most encouraging success.

When I commenced operations my consumption of nitrate of soda was exactly 4 tons 2 cwts. weekly. I have reduced down to 3 tons, and my acid is still of good colour, showing sufficient nitre, and last week my production was rather over my average.

I am now preparing for throwing all the SO_2 from my whole series of furnaces into No. 1, and shall then work Nos. 2 and 3, as I am now doing, at 1·715, and without steam; and all the acid from these two chambers, loaded with nitrous fumes, goes back into No. 1, where, mixing with the hot acid of about 1·5, produced by No. 1, into which steam is thrown in large volume, the nitrous acid is evolved and again becomes available, and so is brought back to its work by a process which makes it theoretically almost impossible for it to escape, although practically there must always be a considerable loss. This regular return of the nitrous acid to the first chamber, Mr. Hofmann will, I think, allow to be an improvement on his theory.

I think I see my way to working with 2 tons nitrate instead of 4 tons 2 cwts.—I am, &c.,

P. Spence.

Manufacture of Sulphuric Acid.

To the Editor of the Chemical News.

Sir,—I have been much interested in the discussion on the above subject, which has appeared in your journal, but I think there is some want of precision in some of the statements that have been made.

In the Chemical News, vol. xxi., p. 106 (*Am. Repr., May, '70, page* 280), there appeared a translated extract from a paper of Mr. Hofmann's containing the statement:—"By this contrivance, it is possible to manufacture sulphuric acid with a consumption of only 1 lb. of nitric acid for 100 lbs. of sulphur burnt." My attention was arrested by this statement, but on enquiry I was informed by an excellent German chemist who had access to the original paper, that Dr. Hofmann merely claimed to manufacture an equal product of sulphuric acid with *one per cent less nitric acid than had formerly been in general use.* This would change the entire aspect of the question, for I know very well that British manufacturers profess to procure an adequate return (say, from 286—294 H_2SO_4, specific gravity 1·836, from 100 of S.) of acid, while they vary in the percentage of nitrate of soda which they consume in the process from 2·5 up to 8 or 9. The quantity of nitrate used very much depends on the chamber room, regularity of working, supply of steam and air, &c., and on this account I am strongly of opinion that, valuable as Dr. Hofmann's suggestion may be (and I intend to give it a fair trial, extending over many weeks unless deterred by its decided failure), I cannot regard it as more than a small item in a very complex question.

From the few data given by Mr. Spence, we may arrive at an approximation to the results obtained by him; and, if my calculations are correct, I think it will appear that Mr. Spence has not yet attained all that he might wish for. Mr. Spence tells us that he requires about 100 tons of acid, sp. gr. 1·845, per week, and that, in making this quantity of acid, he expended 4 tons 2 cwts. of nitrate of soda. Now, if we assume that the production of acid is adequate (294 from 100 S), then Mr. Spence was using, before his late change in working, 12·06 to 100 of sulphur. If, on the other hand, we assume that Mr. Spence, in common with many manufacturers, expends only 8 per cent of nitrate in the case of sulphur, or 4·5 per cent to Mason's ore, then his kilns should consume 51 tons of sulphur, producing 145—150 tons of acid, sp. gr. 1·845, or, if he burn pyrites, 91 tons of Mason's ore, giving 125 tons of acid. The above data are founded on the quantities quoted by Mr. Spence, and are as precise as the absence of the absolute weights used and obtained will permit; but they demonstrate that it is perfectly possible to obtain an improvement, and that a very considerable one, if my calculations respecting Mr. Spence's working be correct. Every manufacturer of oil of vitriol will bear out my experience, which is this—that the economical production of vitriol is a problem which every man must solve in a great part for himself, and that it depends on a variety of conditions, not exactly the same in many instances; but they may be classed into the chemical, the physical, the practical, and the commercial. The first and second of these are of paramount importance, and have not been sufficiently attended to, or all might arrive at a perfection almost complete; the latter involve the consideration of perfection of apparatus, skilled attention to working, and the varying conditions which regulate supply according to price and demand. In conclusion, I may say that I agree with Mr. Gibbins that there is much difficulty in making acid which has absorbed nitrous compounds give them up completely, as I have detected them in the acid, although in much diminished quantity, after dilution, agitation, and boiling.

I fear I have trespassed already too much on your valuable space, so that I must conclude.—I am, &c.,

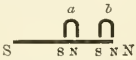
David Basil Hewett, B.A., T.C.D.

Manchester, April 25th, 1870.

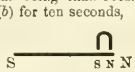
Magnetic Phenomena.

To the Editor of the Chemical News.

Sir,—Having recently met with some curious results in the shape of magnetic phenomena, I take the liberty of transmitting you an account of them. Having magnetised an ordinary needle by means of a small horseshoe (1 inch across at the poles), I floated it on some water, when it arranged itself in the magnetic meridian and exhibited the usual attraction and repulsion to a small bar magnet. The horseshoe was now rubbed to and fro upon the nothern half of this bar (which was four inches long, and about the thickness of a lucifer) for several times from position *a*, in which the horseshoe's south occupies the bar's centre, and its north is intermediate between that of the bar and its centre to position *b*, in which the horseshoe's and bar's north are both in contact, as shown in the annexed diagram,

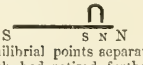


Upon trial it was found that both poles of the bar were now south, attracting the north of the floating needle and repelling its south. A repetition of the experiment on the southern half of a similar bar resulted in two north poles. Another magnetic bar being than obtained, the horseshoe was left in position (*b*) for ten seconds,



when the extremity, which had been thus exposed, was found to repulse the needle's south when presented to it within the space of one-eighth of an inch, and to attract its north when placed in like proximity to it, but, beyond this distance, the reverse phenomena was exhibited the same as before exposure. After exposing in the same way for another ten seconds, the equilibrial points were found to have become situated farther from the needle's extremities, and other repetitions gradually removed them to the distance of half an inch, the south of the floater then always retiring to that distance from the bar's affected extremity or approaching thereto, according as the bar was presented within or beyond it; whilst the floater's north acted in manner precisely reverse. The way in which the south followed the bar when moved slowly excited the impression of its being in some manner moored to it.

Still further exposure to the horseshoe did not produce any further change until it was made at a position nearer the bar's centre: thus—



upon which the equilibrial points separated to greater distances, and, at length, had retired further than the bar's magnetism was perceptible, so that its north pole now appeared an ordinary south, as in the first of our experiments. The result of that experiment being thus obtained in successive steps.

Further experiment yielded analogous results with the bar's other pole, and it was found that contact with the horseshoe in a reversed position always neutralised the effect of contact in the other.

The following experiment was then made with the floating needle:—

Its north was exposed to the horseshoe's north for a short interval as annexed, but not permitted to approach it nearer than the sixteenth of an inch.

Upon refloating, it was found to have lost some of its directive power (shown by its moving more slowly to the magnetic meridian), and by cautious repetition of similar exposure this power was at length totally destroyed, and a floating needle obtained which remained quiescent in whatever position was given to it, and exhibiting two south poles.

To assist in producing these results it may be observed that should the horseshoe's north be applied too long to the needle's extremity, this extremity will become more powerfully south than the other, in which case the needle will not fail to arrange itself as usual. This, however, may be counteracted by a momentary exposure to the horseshoe's south, so that the experimenter will be enabled to bring about the conditions sought in all cases very readily by such alternation.

In conclusion, it may be remarked, that needles with similar poles at both extremities always exhibit the opposite magnetism somewhere within their length, and that the double poled results appear to be permanent.—I am, &c.,

Edward Porter, jun.

478, Crown Street, Sydney.

P.S. I enclose a needle, which was prepared in January, 1869, exhibiting two south poles, as may be proved by floating it and applying a magnetised bar near either extremity, when either will be found to recede from a south and approach a north pole. Care must be taken to prevent the needle's *contact* with any magnet lest its properties be altered.

MISCELLANEOUS.

Female Students of Chemistry.—Yesterday, at the Chemistry Class in the University, the results of the examinations held in the course of the session were announced by Professor Crum Brown, who stated that 13 of the students had attained first-class honours. Their numbers stood as follows:—87, 86, 85, 84, 82, 81, 80, 80, 78, 76, 75, 75, 75. The third name on this list is that of Miss Mary Edith Pechey (85); the tenth that of Miss Sophia Jex Blake (76)—two of the six lady students who, in accordance with the decision of the University authorities at the beginning of the session, had been admitted to study in the medical classes. To the four students whose names stand highest in the Chemistry Class for the session the Hope scholarships fall to be awarded, two of which entitle the holder to attend at the laboratory for the winter and summer sessions, and two for six months only. Dr. Crum Brown, however, announced yesterday that the scholarships would be given, not to the four students highest on the list, but to Messrs. (1) Wilson, (2) Alston, (4) Young, and (5) M'Queen—Miss Pechey's name, which stood third, being thus dropped out, though it was at the same time announced that Miss Pechey was entitled to, and would receive, one of five medals awarded to the five highest students of the session. This decision, which is not, we understand, likely to pass unchallenged, seems the more ungracious when the origin of the scholarships—of what seems her clear right to one of which Miss Pechey has thus been arbitrarily deprived—is considered. They arose out of the success of a course of lectures given a number of years ago by Dr. Hope, then Professor of Chemistry, to a ladies' class held in the University. Dr. Hope was so much gratified by the popularity of these lectures that, with their proceeds (amounting to about £1,000), he founded the scholarships in question. It is rather remarkable that, on the first occasion on which ladies have had the chance of competing for these scholarships, one of them should have triumphantly entitled herself by her position in the class, to this honour and reward—still more remarkable, surely, that she should not receive it. The facts as to Miss Pechey's eminence are even stronger than they appear as stated above; for we understand that both the gentlemen whose names precede hers had attended a previous course of chemistry. So that Miss Pechey's position is absolutely the highest of all the students who may be classed as students of the year, the whole number of the class being about 236, inclusive of the six ladies.—*The Scotsman*, March 29th.

Andersonian University.—We believe that Dr. Clark, assistant to the late Dr. Penny, who delivered the remainder of the winter course of lectures on Chemistry after that gentleman's death, has been appointed to deliver the summer course; pending permanent arrangements consequent upon the proposal of the President, Mr. Young, to endow a chair of technical chemistry.

Opera-House Dirt.—The dust obtained from the places of amusement in New York has recently been analysed by the scientific officers of the Metropolitan Board of Health. Over one hundred specimens of the particles floating in the air, and falling as dust, were collected on plates of glass, and were examined under the microscope. The proportions of the different ingredients varied, but the same substances were found in all the specimens. The composition of the matter subjected to the microscope was as follows:—"The dust of the streets in its finer or coarser particles, according to the height at which it had been collected, with a large proportion of organic elements; particles of sand, quartz, and feldspar; of carbon, from coal-dust and lampblack; fibres of wool and cotton of various tints; epidermic scales; granules of starch of wheat, mainly the tissues of plants; the epidermic tissue, recognised by the stomata or breathing pores; vegetable ducts and fibres, with spiral markings; vegetable hairs or down, either single or in tufts of four or eight, and of great variety, and three distinct kinds of pollens. Fungi were abundant from mere micrococcus granules to filaments of mould. When water was added to a portion of dust from whatever source, and exposed in a test tube to sunlight or heat for a few hours, vibriones and bacteria made their appearance, and the fungous elements sprouted and multiplied, showing that they maintained their vitality, and proving that the germs of fermentation and putrefaction are very widely diffused."—*Scientific American.*

Quality of the Gas Supplied to the Metropolis.—Dr. Letheby, the Chief Gas Examiner appointed by the Board of Trade, has reported to the Corporation of London and the Metropolitan Board of Works the quality of gas supplied to London under the provisions of the "City of London Gas Act, 1868;" and the following are the principal results:—1. *As Regards Illuminating Power.*—This has ranged the case of common gas from 16·70 standard sperm-candles to 17·84, the average of the different companies being as follows:—City Company, 16.95 candles; Chartered, at Leadenhall Street, 17·84 candles, at Gray's Inn Road, 16·70 candles, and at Arundel Street, 17·60 candles; and the Great Central Company, 17·46 candles. The illuminating power of the Cannel gas has been 24·12 candles in the case of the Chartered Company, and 26·09 in that of the City Company. 2. *In Respect of Purity.*—Sulphuretted hydrogen has been always absent from the gas of all the Companies, except on one occasion, when it was accidental. The average amounts of sulphur in other form than sulphuretted hydrogen were as follows:—9·54 grs. per 100 cubic feet of the Cannel gas of the City Company, and 25·82 (or nearly three times as much) in that of the Chartered Company; 14·19 grs. per 100 cubic feet of the Great Central gas; 19·99 grs. in the common gas of the City Company; and 22 47 grs., 24·43 grs., and 29·31 grs. in that of the several stations of the Chartered Company. These results show that the amount of sulphur in the gas of the Chartered Company is largely in excess of that of the City and the Great Central Companies; and considering the mischievous effects of this impurity, it is highly necessary that the proportion of it should be kept down to the smallest amount. Ammonia has been always absent from the City

Company's gas; but it has ranged from 0·86 of a grain per 100 cubic feet to 4·9 grs. in the gas of the Chartered Company, the average for the quarter being 0·86 gr., 1·4 grs., 3·28 grs., and 2·1 grs. in the gas at the several stations of the Chartered Company, and 2·1 grs. per 100 cubic feet of that of the Great Central Company.

Humid Copper Process, Invented by Dr. Sterry Hunt.—The ordinary process for the manufacture of cement-copper consists in the solution of the copper compounds (generally by means of acids) and the precipitation of the metallic copper by the addition of iron. This method is open to two objections. One is the waste of iron, resulting from the fact that, of the iron added, a part remains in solution without precipitating any copper, and another part is itself precipitated with the copper. The other objection is the contamination of the product arising from this precipitation of a portion of the iron with it. The ingenious process of Messrs. Hunt and Douglas obviates these objections by a change in the method of effecting a solution. The preliminary roasting of sulphuretted ores, and the final precipitation with metallic iron, are the same as in the ordinary process; but the chemical reactions of the solution are widely different. The evils we have alluded to arise from the acid solutions employed, and the per-salts of iron contained in them. The peroxide of iron in the bath, whether in combination with sulphuric or muriatic acid, absorbs a portion of the metallic iron, and becomes reduced to protoxide; while a portion of the per-salts falls in a basic, insoluble precipitate. These unstable per salts should, if possible, be avoided. Again, the subchloride of copper contains twice as much copper in proportion to the chlorine as the protochloride. The ordinary precipitation substitutes iron for the copper of the protochloride, making metallic copper and protochloride of iron; but the same iron would suffice to expel 2 equivalents of copper from the dichloride. Thus—

$$Cu\,Cl + Fe = Cu + FeCl$$
$$Cu_2Cl + Fe = 2Cu + FeCl$$

It is evident, therefore, that the more dichloride of copper is present in the solution the less iron will be required for the precipitation. The theoretical amount required for a protochloride solution is, as we have said, 88·3 parts of iron for 100 of copper. The theoretical amount for dichloride is half as much, or 44·1 parts of iron. For mixtures of the two, the proportion of iron required by theory would vary between these two limits, according to the proportions of the proto- and di-chloride of copper. But this desirable dichloride of copper is insoluble in water, and in the ordinary process its presence would be troublesome. The bath employed on the new process, however, permits its formation, and holds it in solution. This bath is a solution of neutral protochloride of iron, with a certain proportion of salt. The former acts upon the oxidised copper, producing a mixture of dichloride and protochloride, and precipitating at once peroxide of iron. The salt holds the copper salts in solution, and the liquid is drawn off from the insoluble residuum. From this liquid, by the addition of metallic iron, the copper is precipitated. By this means, all absorption or precipitation of iron in the last operation is avoided, and, at the same time, the theoretically-necessary quantity is reduced, since a large portion of the copper (about two-thirds) is dichloride. It is found easy in practice to produce 100 lbs. of pure cement-copper by the use of about 60 lbs. of iron.—*Engineering and Mining Journal*, U.S.A.

Explosion of Fulminating Gold.—We are indebted to Mr. William A. Sweet for the following details of a curious explosion which lately occurred at a jeweller's establishment in Syracuse. A quantity of gold scrap had been dissolved in nitro-muriatic acid and precipitated by ammonia. The entire material being then placed over a register to evaporate was left there, in an earthern jar, until dried. It was then removed, and when cool, the operator, who had evidently not studied the chemistry of gold, proceeded to scrape out the dry precipitate into a sheet of paper; a serious detonation soon occurred, and pieces of the jar were driven through a thick plate-glass screen, making clear holes, without cracks, so high was their velocity. We are not told what became of the operator, but fear the worst. It is almost superfluous to add, that if, as is probable, an excess of ammonia was added in precipitating the gold, the entire process was exactly that given in most chemical works for producing fulminating gold in its most explosive condition.—*Communicated by Prof. Morton.*

New Magnesia Burner.—During a visit which we lately made to the works of the New York Oxygen Gas Co., 547, West 41st Street, we saw a new burner in operation which had just been received from France, and which successfully meets the difficulty previously found in burning the oxygen light, with a very low pressure on the "burning-gas." Each elementary burner consists of three very minute jets, two at either side coming somewhat towards each other, which are supplied with the ordinary gas, and the other between them, and a little shorter, which is fed with oxygen. By this means, no matter how low the pressure on the illuminating-gas may be, no retreat of the flame into the jet can occur. We saw this burner, in fact, operating most excellently with a pressure of about 2-10th inch of water. We hear from Mr. C. H. Stoddard, that a yet further improvement is announced, of which specimens will soon be on hand.—*Communicated by Prof. Morton.*

Use of Calcium Lights at the Saint Louis Bridge.—From Mr. W. Milnor Roberts, who is in charge of the work, we hear as follows:—"We have used calcium lights only for our open-air work in laying masonry on the top of our caissons—one light on one side, and one at the other, on diagonal corners; we found that they distributed the best light when thus placed. We had the oxygen gas forced into copper gas-holders with a pressure of about 200 lbs. to the square inch. These were carried over from the city to the piers on a little steamer, and the gas was conveyed to the burner through small lead pipe. At first our reflectors were of glass, but so many were broken that they were replaced by metal. A man remained with the two burners through the night, to regulate them occasionally, and to mend the pipes when a burst occurred. They usually burn from eleven to twelve hours; and, with the aid of some movable large reflector lamps, the masons worked as well at night as in the day. The cost of the calcium lights to our company was 3·75 dollars per hour each."—*Communicated by Professor Morton.*

Death of Dr. Magnus, of Berlin.—We learn with great regret that the celebrated physicist, Dr. Heinrich Gustav Magnus, of Berlin, died there on the 4th inst.; the deceased was born at Berlin on the 2nd of May, 1802, and took the degree of Ph.D. at Berlin University in 1827, his inaugural dissertation written in Latin bearing title "De Tellurio." In 1834 he was appointed Extraordinary Professor of Natural Philosophy at Berlin University, and in 1845 became Ordinary Professor for the same subject. The deceased largely contributed to extend our knowledge of physical sciences, but owing to the great mass of his various contributions, it is quite impossible to give here even a brief outline of his labours. The deceased was a member of several scientific societies and institutions, and carried on a regular correspondence with the foremost scientific men in the civilised world.

Description of Browning's Automatic Spectroscope.—This instrument is furnished with a battery of six equilateral prisms of dense flint glass; all the prisms are joined together like a chain by their respective corners, the bases being in this manner linked together. This chain of prisms is then bent round so as to form a circle with the apices outwards; the centre of the base of each prism is attached to a radial rod. All these rods pass through a common centre. The prism nearest the collimator, *i.e.*, the first prism of the train, is a fixture. The movement of the

other prisms is then in the proportion of 1, 2, 3, 4, and 5, the last or 6th prism moving five times the amount of the second. All these motions are communicated by the simple revolution of the micrometer screw, which is used for measuring the position of the lines in the spectrum, and the amount of motion of each, and of the telescope, is so arranged that the prisms are automatically adjusted to the minimum angle of deviation for the ray under examination. It is easy to test the efficiency of the instrument in this respect. On taking the lens out of the eye piece of the telescope, the whole field of view is found to be filled with the light of the colour of that portion of the spectrum which the observer wishes to examine; while in a spectroscope of the usual construction, at the extreme ends of the spectrum, just where the light is most required, only a lens-shaped line of light would be found in the field of view. As a consequence of this peculiarity, the violet and deep red ends of the spectrum are greatly elongated, or rather much more of them can be seen than in an ordinary spectroscope, and the H lines, which are generally seen only with difficulty, come out in a marked manner.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the month, with abstracts of all susceptible of advantageous abridgment. The two half yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note.—*All degrees of temperature are Centigrade, unless otherwise expressed.*

Meteorite Observed at Alicante, Spain.—C. Miallej de.—The author states that, just about sunset on the 2nd inst., he observed, while walking on the pier (the town is situated on the Mediterranean), a meteorite, much akin in size, colour, and shape to, but far larger than, the planet Jupiter, moving with great speed from east to west.

Artificial Butter.—Dr. Mège.—When the stearic acid employed for making the so-called stearine candles, is strongly pressed (as is always done in its manufacture, to get rid of the oleric acid), an oily substance is obtained which, according to this author, is identical in composition with butter, but fluid. The author submits this material to several processes of infusion, decolouration, and beating (a kind of churning), and at last converts it, also, in physical appearance, into butter. The editor of this paper very properly adds that the Cossacks understand this matter far better, and with less ample machinery, since they, it is well known, are in the habit of converting oils readily into an unctuous substance by a simple process. The rationale, in both cases, is a partial saponification.

Journal für Praktische Chemie, No. 21, 1869.

This periodical contains the following original papers and memoirs:—

On Benzoic Acid and Gum Benzoin.—Julius Löwe.—The contents of this paper are the answers given to four queries, viz.:—(1) Does benzoic acid pre-exist in gum-benzoin ready-formed and in free state? (2) Is the benzoic acid present in the resin combined with a base? (3) Is benzoic acid a product of the oxidation of a part of the resin formed by the taking up of oxygen during the melting of the resin? (4) Is benzoic acid a product of a portion of the resin formed by the heat of the fusion of that substance? The author's experiments, detailed at great length, commenced with the finding of a reply to No. 3, and the result is a negative—viz., that when the process of sublimation (as usually employed for obtaining benzoic acid from gum benzoin) is carried on in atmospheres of hydrogen or carbonic acid gas, the quantity and quality of the acid obtained are the same as when the process is carried on in contact with air. As regards the replies to Nos. 1, 2, and 4, a series of experiments made in various ways proved, undoubtedly, the pre-existence of ready-formed benzoic acid in the resin. The last portion of this paper is devoted to the very minutely-detailed description of the best practical method of the preparation of benzoic acid from the resin.

Composition of Soda and Lime Felspar.—G. Tschermak.—Since some doubt has arisen concerning the proper place to be assigned, in chemical mineralogy, to the minerals just named, the author made analyses of carefully-selected minerals, with the following results for 100 parts:—Silica, 48·94 and 49·40; alumina, 33·26 and 32·60; lime, 15·10 and 15·05; soda, 3·30 and 2·95. The second numbers refer to and prove these felspars to be mixtures of 75 per cent of anorthite and 25 per cent of albite. The sp. gr. of the samples was, respectively, 26·72 and 2·723.

On the Haloid Compounds and their Derivatives Corresponding to Picric Acid and Dinitro-Phenol.—Conrad Clemm.—(Preliminary notice.) After briefly referring to Pisani's labours on this subject, the author says that the chloro-trinitro-benzol, obtained by causing pentachloride of phosphorus to act upon picric acid, is converted, by the action of ammonia and aniline, into trinitraniline and trinitro-diphenylamine, which latter substance yields, with sulpho-cyanide of potassium, a body, $C_{14}H_{11}N_8SO_{12}$. Chloro-dinitro-benzol has been prepared by the author from dinitro-phenol, as well as from chlorbenzol; both products are identical, and fuse about between 48° and 50°. By means of these compounds, it is possible readily to prepare from benzol, phenol derivatives. Dinitraniline has been prepared by the author by means of bi-nitrated bromobenzol, as, also, by means of chloro-dinitro-benzol; both products are identical, and their melting-point is 175°. Aniline and bromo-dinitro-benzol yield dinitro-diphenylamine, fusing at 153°. These researches will be continued, and the action of pure solid fused phenol upon sulphocyanide of potassium and upon sulphate of diazo-benzol will be investigated fully.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, No. 205, January, 1870.

This number does not contain any original papers relating to chemistry, but we meet here with a very extensive report, accompanied by several engravings, on—

Electric Clockwork and Machinery for Striking Hours and Quarters by means of Electric Action, as Executed by M. Fournier and Reported on by O. Tresca.

Moniteur Scientifique, No. 318, March 15, 1870.

This number contains the following original papers relating to chemistry and allied sciences:—

Quantitative Estimation of Sugar.—Georges Ville.—This paper, too lengthy for any useful abstraction, is divided into the following sections:—Apparatus required, illustrated by wood cuts; reagents; estimation of total quantity of sugar; estimation of glucose; calculation of results; estimation of sugar in vegetable tissues; estimation of sugar in vegetable juices; tabulated form to assist in the calculations.

Determination of the Commercial Value of Bleaching-Powder and Manganese.—G. Tissandier.

Some Experiments with Salts of Chromium.—A. Commaille.—This lengthy paper contains the following sections:—Nitric acid and bichromate of potassa; sulphuric acid and bichromate of potassa; chlorhydric acid and bichromate of potassa; iodic acid and bichromate of potassa; oxalic acid and bichromate of potassa; acetic acid and bi-

chromate of potassa; tartaric acid and bichromate of potassa; citric acid and the same salt; tannic acid and the bichromate alluded to; and, lastly, benzoic acid and the same salt.

Chemical Dance: Instantaneous Apparition of Aniline Colours.—Under this title, a somewhat verbose, but, after all, elegantly-described curiosity, is related as follows:—Some few weeks ago, Madame A. W. Hofmann gave a grand entertainment and ball to the large number of her eminent husband's pupils. In the ball-room were placed, on the table, a large number of bouquets of flowers (artificial, of course), all snow-white, and close by, on the same table, a large number of pieces of beautifully-white silk ribbon; at the other end of the room a fountain was arranged, throwing, from narrow openings, jets of exquisitely-perfumed eau de Cologne. The bouquets were taken by the ladies, and the ribbons by the gentlemen; and while waltzing together, and thus arriving at the end of the room where the fountain played, the ladies, holding their bouquets to be sprinkled over with the perfume, beheld the white flowers become suddenly beautifully red, violet, blue, yellow, and green-coloured, while the ribbons carried by the gentlemen assumed, under the same influence, similar colours. The secret of this trick is simply that the objects alluded to had been very gently dusted over with the dry powders of variously-prepared aniline colours, and, on becoming moistened by the eau de Cologne (alcohol), these powders became dissolved, and imparted colours to the objects.

Bulletin Mensuel de la Société Chimique de Paris, February, 1870.

From the *procès verbaux* of the meetings of this Society held in the month of January last, we learn, in the first place, that Ch. Friedel is the president of the Society for the present year, and MM. J. Bouis and E. Willm, secretaries. M. Terreil made a communication on the progress of his researches on the—

Treatment of Minerals by Saline Solutions.—(More especially alluding to the action of alkaline sulphides on native metallic sulphides.) Sulphide of antimony is readily dissolved; realgar (arsenical sulphide) is only incompletely dissolved; while the sulphides of tin and molybdenum (native) are not at all acted upon. Native sulphide of nickel and the white-coloured iron pyrites (mundic), also the magnetic pyrites, are slowly dissolved; but the yellow-coloured variety (coal brasses) is not acted upon. All minerals which contain sulphides of arsenic and antimony, as, for instance, ruby silver ore (grey antimony ore), are decomposed by alkaline sulphides; but mispickel, for instance, which is a metallic arsenide combined with sulphur, is not attacked by these solvents. Mispickel is an arsenical pyrites, containing iron, arsenic, and sulphur.

The President of the Society stated that he had been engaged with Dr. Ladenburg in researches on the—

Products of the Oxidation of Acetone.—Among these, mesoxalic acid has been found.

Dr. Wurtz spoke on the—

Synthesis of Organic Acids which can be obtained by Starting from Chlorinated Hydrocarbons by the Action of Chloroxycarbonic Ether in the Presence of Sodium.—Bromide of benzyle, treated with chloroxycarbonic ether and sodium amalgam, yields, with proper precautions, a complex crystallisable acid, $C_{18}H_{14}O_2$, dibenzyl-carboxylic acid, resulting from the action of one molecule of chloroxycarbonic ether upon two molecules of chloride of benzyl. The lime-salt of this acid yields, when submitted to destructive distillation, two hydrocarbons—viz., dibenzyle, $C_{14}H_{14}$; and stilben, $C_{14}H_{12}$.

The following papers were read:—

Chemical Equilibrium Existing between Carbon, Hydrogen, and Oxygen.—M. Berthelot.—This lengthy paper, which contains, also, the history of the earliest researches on the action of electricity upon gaseous compounds, is divided into the following sections:—Decomposition of carbonic acid; decomposition of aqueous vapour and steam; equilibrium between hydrogen, oxygen, and carbon; action of electric sparks upon mixtures of gases.

Spectra Exhibited by some Compound Bodies Present in Mixtures in the State of Equilibrium.—Dr. Berthelot and J. Richard.

Bromo-Tolnen and Pseudo-Tolnidine.—A. Rosenstiehl.—This paper is a very lengthy and sharply-critical reply to M. Wallach, who published an article under the above heading in the January number of this periodical.

Revue Hebdomadaire de Chimie, March 10, 1870.

Apparatus for the Evaporation of Beet-Root Juice, designated as *à Triple Effet*.—M. Schreiber.—A description of a very useful contrivance for the utilisation of waste steam for the purpose of evaporating the juice while circulating, so as to obviate, as much as possible, the formation of calcareous deposits from the juice against the sides of the evaporating pan.

Volumetrical Assay of the Iodine of Commerce.—A. Bobierre.—An aqueous solution of iodide of potassium of known strength is made and kept invariable for a number of assays; this solution being destined to dissolve the iodine to be tested. Next, a solution (normal) of arsenite of soda is made, by dissolving, in a litre of water, 4·95 grms. of arsenious acid and 14·5 grms. of crystallised carbonate of soda (pure); this liquid completely decomposes any iodine containing liquid, the quantity of that haloid amounting to 12·688 grms. to the litre. A solution of bicarbonate of soda in cold water is made, rather concentrated, to be used as will be indicated presently. Take a small glass-stoppered bottle; pour into it 10 c.c. of the arsenite of soda solution and 5 c.c. of the bicarbonate of soda solution, and next 4 c.c. of benzol. Weigh off any quantity of a sample of pure iodine; dissolve it in a quantity of the above-mentioned solution of iodide of potassium, fill with this solution, which is, of course, brown-coloured, a bottle of 100 c.c. capacity. Shake the bottle containing the liquid, and pour, *guttatim*, into a graduated burette; the brown colour will disappear, the benzol becomes rose-coloured, and the aqueous liquid yellowish. It is clear that a second assay, made with the same quantity, by weight, as the first, but of the iodine to be tested, will give as result the richness of the sample in iodine, because the bulk of the solution required for the decomposition of the alkaline arsenite is inversely proportioned to the real quantity of iodine sought for.

Process of Sugar Manufacture.—M. Mueseler.—This process is based upon capillary action, but the description here given is too vague to give any adequate idea of its practical applicability.

Testing of Alcohol and Spirits for Amylic Alcohol.—Since the internal use of amylic alcohol, even in small quantity, is very deleterious, the means of rapidly testing for its presence in spirits and alcohol (either for pharmaceutical or scientific use) is of importance. The suspected alcohol is poured into a burette, mixed with its own bulk of rectified and pure ether, and also its own bulk of water, and the mixture gently shaken; the ether, on becoming separated from the rest of the fluid, floats to the top, containing in solution the whole of the amylic alcohol which might have been contained in the alcohol or spirits under examination. The ether is removed by a pipette, and on leaving it to spontaneous evaporation, will leave behind the amylic alcohol, readily detected by its offensive smell.

Description of a Newly-Invented Apparatus for Preparing Animal Charcoal.—MM. Guilbert, at Eth (Dep. du Nord).—Accompanied by woodcuts.

Preparation of Neutral Perchloride of Iron.—M. Bouilhon.—This process may be summarised as follows:—Dissolving of iron in dilute hydrochloric acid, aided by

heat; evaporation of the solution obtained, and crystallisation; solution of the crystals in distilled and previously well-boiled water, cooled without contact of air; passing a slow current of chlorine through this solution while in rather concentrated state.

Preparation of Caffeic Acid.—J. Hlasiwetz.—Take of extract of coffee (raw or green), 50 grms.; dissolve in 120 c.c. of tepid water; add 50 grms. of caustic potassa. Boil this mixture for an hour in a large retort provided with a condenser; saturate the potassa with sulphuric acid; shake the mixture three times with fresh quantities of ether; remove that liquid by distillation, when crude caffeic acid is left, which is dissolved in water and purified, by means of animal charcoal. From the above-quoted quantity, 6 grms. of the pure acid are obtained.

Estimation of Bromide of Potassium Mixed with Chloride.—Dr. Baudrimont.—Test the sample qualitatively, first, for carbonate and the presence of iodide, since especially the latter renders the bromide unfit for medicinal use, and its presence would also interfere with the process of analysis to be described. (It should be remembered that 1 grm. of bromide of potassium requires for precipitation exactly 1·428 grms. of nitrate of silver, and that 1 grm. of chloride requires exactly 2·278 grms. of the same nitrate for the same effect.) Dissolve 1 grm. of the suspected bromide in 100 c.c. of distilled water; take 10 c.c. of this solution, which precipitate completely, by a solution of nitrate of silver *au centième* (1 part in 100 of water), poured out of a burette graduated so as to be enabled to read off tenths of c.c. If the bromide is pure, 142 of the divisions of the burette filled with the nitrate of silver solution will be required; if the salt contains chloride, more of that solution will be required; and, since the perfectly pure chloride would require 227 divisions, it is readily found by calculation what amount of chloride the bromide contains.

Adulteration of Sub-Nitrate of Bismuth.—This salt has been of late frequently sophisticated with phosphate of lime (bone-ash). To detect this, the salt in question may be dissolved in nitric acid, and this solution precipitated by carbonate of potassa solution. If the bismuth-salt is pure, it is re-dissolved in excess of that precipitant; but any phosphate of lime present is not rendered soluble by this reagent. Of course other sophistications may exist, and therefore proper tests have to be applied to ascertain the nature of the substance.

Les Mondes, March 17, 1870.

Imperial Society of Sciences at Lille (Nord, France).—Prize of 1000 francs (£40) for the best work on any of the subjects of experimental natural philosophy on which hitherto no monograph has been published (by this Society?); June 1st, 1870. Same-valued prize for a work on clinical thermometry; October 1st, 1872. Gold, silver-gilt, silver, or bronze medals for—An elementary work for schools, on the mechanical theory of heat, and its applications to machinery; researches concerning the different qualities of butcher's meat, with proper elucidation of the cause why inferior qualities of meat are less nutritive, for the same weight, than better ones; description of the simplest means of obtaining proper ventilation in cafés, estaminets, and other rooms, by the aid of the ordinary methods of lighting and heating; renewed study of the chemistry of sugar manufacture (beet-root); renewed study of colouring matters; renewed study on bleaching materials. We have left out all questions belonging to physiology and natural history, as well as those of local importance only.

Pneumodensimeter.—A. de Negro.—Description, illustrated with several engravings, of very great and important improvements effected in Bunsen's apparatus for the estimation of the specific gravity of gases, by determining the duration of their flow through very narrow openings, or through very thin plates. The apparatus, as described, is self-registering.

American Journal of Pharmacy, March, 1870.

Contains the following original papers relating to chemistry and allied sciences:—

Notice of M. Carre's Apparatus for Ice-Making.—W. Procter.—It appears from this paper that this invention, wherein ammonia gas liquefied by pressure is applied, is a decided success.

Reaction between Spirit of Nitrous Ether and Bicarbonate of Potassa.—Dr. Rademaker.—The author states that, while keeping sweet spirits of nitre, prepared according to the U. S. P., in a bottle containing, as advised, bicarbonate of potassa in crystals, he observed these crystals change form. On examining the same, and applying tests, he found that nitrite of potassa had been formed, while the liquid, which had been prepared with great care, was neutral to begin with and had remained so; no perceptible solution had taken place. Aqueous solution of bicarbonate of potassa readily decomposes the fluid in question.

Assay of a Pure American Opium.—W. Procter, jun.—In 100 parts, this sample, obtained from plants grown from foreign seed, contained—Morphia, 15·75; impure narcotine, 2·0; meconic acid, 5·25; caoutchouc, fatty matter, and resin, 11·00; residue insoluble in benzol (including 0·5 ash), 22·0; matter soluble in water, other than salts of morphia and narcotine (as gum, extractive, &c.), 38·5; water, 5·0. No attempt was made to isolate codeia, narceia, meconine, and the like.

On Sulpho-Carbolic Acid and Sulpho-Carbolates.—W. Procter, jun.—Too lengthy for useful abstraction. An excellent paper for perusal for good methods of preparation of these substances.

Zinc Sulpho-Phenate.—Dr. Hagar.—A lengthy paper on the preparation of this salt for pharmaceutical use.

Solution of Citrate of Magnesia.—B. Rother.—This paper contains an excellent review of the various salts citric acid and magnesia yield, and a good formula for the preparation of a pharmaceutically-useful solution of a citrate of magnesia, soda, and potassa.

This number contains, in addition to the papers alluded to, several good papers of purely pharmaceutical importance.

Comptes Rendus des Séances de l'Académie des Sciences, March 21, 1870.

The number contains the following original papers and memoirs relating to chemistry and allied sciences:—

Analysis of, and Useful Applications of, Gaize.—H. Sainte-Claire Deville and J. Desnoyers.—There occurs, in the Departement des Ardennes, France, a variety of hydrated silica known by the name of gaize, and geologically situated below the cretaceous deposit; the thickness of this layer is 30 metres, and it extends over a distance of 40 kilometres (24·85 English miles). The sp. gr. of this substance is 1·48 in crude state, and after ignition 1·44; in 100 parts, it consists of—Hygrometrical water, 3·4; combined water, 3·2; soluble silica, 43·7; insoluble silica, 40·8; alumina, 3·8; peroxide of iron, 2·9; lime, 0·9 (we only quote one of the very large number of analyses mentioned in this memoir). This stone is used as a building stone; it is, at first, quite soft, so that it can be cut with a knife. Since the authors found that this material resists a very high temperature without fusion or cracking, or, also, of perceptible contraction, either cubical or linear, they recommend it for the manufacture of crucibles (on the lathe), for fire-bricks, and for furnaces. Some specimens of bricks and crucibles made from this material were exhibited at the meeting.

Variations of the Calorific Capacity of Water when Approaching its Maximum of Density (Specific Gravity).—M. Hirn. A memoir of considerable length, and too full of figures to admit of useful abstraction.

Action of Sulphide of Carbon and Carburetted Gases (des gaz carburés) on Wood Charcoal.—J. Sidot.—The author describes, at some length, a series of experiments made by him. When the vapours of sulphide of carbon, of wood-spirit, and some of the liquid hydrocarbons are passed over wood charcoal at an elevated temperature, that substance undergoes, at least superficially, a very curious change, and is converted into a sonorous, metallic-looking material, becoming, at the same time, a good conductor of heat and electricity, and no longer capable of absorbing gases; it is, in fact, converted into a peculiar kind of graphite, but only superficially.

On Cobalt and Manganese, and their Alloys with Copper.—A. Valenciennes.—The author exhibits specimens of cobalt and manganese fused in crucibles made of magnesia. The former metal is very similar to iron, but far harder, yet readily wrought in the lathe. Manganese is a very hard, but brittle metal, very readily oxidised in the air; the specimen was pure, having been made from pure peroxide. Notwithstanding the similarity cobalt possesses to iron, the former readily alloys with copper, which iron does not. The alloys of manganese and copper are very similar to those of copper and tin, but very hard and brittle when the proportion of manganese is above 8 per cent of the mixture.

Vertical Beam Galvanometer.—M. Bourbouze.

Electro-Chemical Essay on Ozone.—E. Martin.—This paper was not read—its title only is mentioned.

Nature of the Motive Power which Produces the Phenomena of Endosmosis.—A. Rosenstiehl.—This lengthy memoir, full of quotations from other periodicals, is not well suited for any useful abstraction.

New Method of Preparation of Bromhydric Acid.—MM. Champion and Pellet.—This process is based upon the reciprocal action of the vapours of bromine upon those of paraffin, the latter substance being heated to 185°, and the former to 65°, each in a separate retort. The somewhat complex reaction results, ultimately, in the formation of bromhydric acid, of which, by this means, a concentrated aqueous solution is obtained, which, if saturated at 0° (32 F.), has a sp. gr. of 1·78, and contains in every c.c, 1·46 grms. of bromhydric acid, while the formula of this compound is $BrH_{11,2}HO$. On being heated, gas is evolved; but, simultaneously, a hydrate is obtained boiling at 126°; its formula is $BrH_{11,10}HO$; its sp. gr. is 1·48.

Properties of Iodic Acid.—A. Ditte.—This very lengthy and exhaustive memoir treats (1) on anhydrous iodic acid, and (2) hydrated iodic acid. The paper is a monograph on the subject, but not suited for any useful abstraction.

Hydrogenated Derivatives of Sulphide of Carbon.—Aime Girard.—After referring to older experiments made on this subject, the author states that he has succeeded in substituting hydrogen for half of the sulphur contained in sulphide of carbon, thus constituting a compound containing equal equivalents of carbon, hydrogen, and sulphur. By analysing the compounds this new substance forms with nitrate of silver, chloride of mercury, and chloride of platinum, the author has been enabled to fix the formula of this substance as $C_4H_4S_4$, and that it is bisulpho-methylen. The formula of the platinum compound is—

$$C_{12}H_{12}S_{12}.2PtCl+2(C_{12}H_{12}S_{12})4PtCl_2=$$
$$=3(C_4H_4S_4)2PtCl+5(C_4H_4S_4)4PtCl_2.$$

In 100 parts—Carbon, 12·2; hydrogen, 2·0; sulphur, 32·5; platinum, 33·3; chlorine, 20·0.

Vitality of Beer-Yeast.—J. Melsens.—This lengthy chemico-physiological memoir is divided into the following sections:—Fermentation at 0° (32 F.); freezing of beer-yeast under pressure; freezing of beer-yeast, or of malt, in solution, by means of the paste of ether and solid carbonic acid *in vacuo*; resistance of beer-yeast in wort at a higher temperature; destruction of the vitality of beer-yeast, when the fermentation, produced by it, and going on in a closed vessel, causes the pressure to rise to 25 atmospheres (375 English lbs.) pressure to the square inch. The chief results of the author's researches are: That fermentation is possible in the midst of melting ice, at which temperature seeds do not germinate. Beer-yeast resists (that is, is not deprived of its capability of inducing fermentation) freezing when surrounded by water, and resists the effort of dilatation (expansion) which is so strong as to break vessels capable of resisting 8,000 atmospheres' pressure (120,000 lbs.) to the square inch. The energy of the ferment is diminished, but its vitality is not destroyed, by the lowest possible temperature which can be artificially made—viz., about 100° C. below zero. Alcoholic fermentation is suspended when the temperature is maintained for some time at 45° (113° F). Alcoholic fermentation is arrested, when that operation is going on in closed vessels, as soon as the carbonic acid evolved causes a pressure of 25 atmospheres, and in that case the yeast is killed (*tuée*). The following observations on the contents of this paper were made by M. Boussingault, who says—"It is not at all remarkable that beer-yeast should resist the action of very low temperatures, since the same has been observed with various kinds of seeds purposely exposed to a cold of—100°, which seeds germinated afterwards." But the speaker takes exception to the fact announced that fermentation should go on at a very low temperature, and states that when he repeated, during the very great cold of the winter of 1848, Vergnette's experiments, he found that ferments were killed and fermentations arrested by that low temperature.

Chemical Conditions of the Life of the Lower Organised Animals.—J. Raulin.—A physiologico-chemical paper.

On Tribromhydrine.—L. Henry.—The author describes, at great length, the preparation of this body, which, in pure state, is a neutral, colourless, ethereal liquid, of 2·407 sp. gr. at 10°, insoluble in water, and boiling at 219°; by the aid of a low temperature, it can be obtained in crystalline state. Its equivalent is 281; its percentage composition—Carbon, 12·81; hydrogen, 1·78; bromine, 85·40. Formula, $C_3H_5Br_3$. The author enters into some details on the action of caustic potassa upon this substance, but has not quite finished his researches in this direction.

Isomeric Xylens and Cumens met with in Coal-Tar Oils.—M. Rommier.—A continuation of a former paper on this subject.

Fall of a Meteorite at Mourzouk (Barbary).—M. Coumbary.—The author, writing from Tripoli, states that, on the 25th of December last, there was observed, at Mourzouk (Fezzan), lat. 26° N., long. 12° E. of Paris (14° 20′ 26″ E. of Greenwich), a most extraordinary fall of a meteorite, accompanied by a heavy report of an explosion, and so strong a scintillation of sparks that a group of Arabs, who were near the spot, became so frightened that they fired their guns at the heavenly monster. The Turkish Government has very laudably taken proper measures to secure the meteorite; but, since the distance from Tripoli to Mourzouk is very great, and the roads hardly fit for traffic, it is a month's journey to reach the latter place. At the end of this letter, it is incidentally mentioned that, in the farther interior of this region (Africa), the Sultan of Wadai, and all the grand personages of his Court, are armed with swords, lance-heads, and sabres made from iron fallen from heaven, which is very abundant there.

Revue des Cours Scientifiques de la France et de l'Etranger, March 26, 1870.

This number does not contain any papers relating to

[English Edition, Vol. XXI., No. 540, pages 153, 154.]

chemistry, but we quote the titles of the following memoirs of general scientific interest met with in these pages:—

Existence of Man at the Tertiary Period.—A. Favre.

Spectroscopic Observations of the Solar Protuberances.—G. Rayet.

Action of the Sympathetic Nervous System.—Dr. P. Bert.—A public lecture given to a mixed auditory at the Sorbonne, illustrated with diagrams.

Revue Hebdomadaire de Chimie, March 17, 1870.

Manufacture of Carbonate of Soda.—MM. Schlœsing and Rolland.—This process is based upon the reaction which takes place when carbonate of ammonia reacts upon common salt, both salts being in aqueous solution. There is thus obtained bicarbonate of soda of great purity, which crystallises; and in the solution there remain chloride of ammonium and an excess of the bicarbonate of that base.

Peruvian Guano.—Ch. Mène.—It appears that the Peruvian Government has come to the decision that no guano from the Chincha, Macabi, and other islands, may be exported, except to the United States and the United Kingdom, with the view of settling, by this means, the debts owed by Peru to these countries. The author enters into some details about the fixation of the ammonia in this substance.

Regenerating Stale and Ropy Beer.—M. Mène.—According to this process, the liquids alluded to are boiled up, first, with spent hops, and afterwards fermented again; but it is very difficult to see that this treatment can do any good. It is best to use such fluids as stale and ropy beer either for vinegar making or throw it away into the manure of the horses employed at the brewery, since that is its best place.

Zeitschrift für Chemie von Beilstein, No. 4, 1870.

This number contains the following original papers and memoirs:—

Further Researches on the Constitution of Piperic Acid.—J. Remsen and R. Fittig.—The authors have studied the action of hydrogen, in nascent state, upon piperonal and piperonylic acid. The first of these substances yields, when treated with sodium amalgam and water, three different and well-characterised substances, viz:—Piperonyl alcohol, $C_8H_8O_3$, a solid body, fusing at 51°, crystalline, difficultly soluble in water, readily soluble in alcohol, not volatile without undergoing decomposition, and yielding, with chloride of acetyl a fluid acetic ether, while hydrochloric acid is given off. Hydropiperoine, $C_{16}H_{14}O_6$, a solid body, insoluble in water, and also in cold alcohol; difficultly soluble in boiling alcohol, from which solution it crystallises on cooling, exhibiting lance-shaped crystals fusing at 202°. Isohydropiperoine, $C_{16}H_{14}O_6$, a solid substance, insoluble in cold water, but readily in boiling, very soluble in alcohol, crystalline, and fusing at 138°. The authors describe, at great length, the action of the two last-named substances, in contact with chloride of acetyl and with nitric acid; the result, as regards the latter, being mono-nitropiperonal, $C_8H_5(NO_2)O_3$, a solid crystalline body, insoluble in water when cold, but better soluble in hot water and boiling alcohol, and fusing at 95°. This very lengthy memoir contains, further, the account of the action of chloride of phosphorus upon piperonal, represented by—

$$C_7H_5O_2-CHO+PCl_5=C_7H_5O_2-CHCl_2+PCl_3O,$$

producing piperonal chloride, a fluid boiling at between 230° and 240°. By the action of water and dilute hydrochloric acid, piperonylic acid yields protocatechuic acid and pyrocatechin.

Isomeric Nitrotoluols and Toluidines.—F. Beilstein and A. Kuhlberg.—This paper contains the description of the following compounds:—Nitrited acetoluide, $C_7H_6(NO_2)$, NHC_2H_3O, a solid substance, fusing at 92°, and insoluble in water; isomeric nitrotoluidine, $C_7H_6(NO_2)$, NH_2, a solid crystalline body, readily soluble in alcohol, and fusing at 114°; ortho-nitrotoluol, $C_7H_7NO_2$; ortho-toluidine; ortho acetoluide, C_7H_7, NHC_2H_3O; dinitrotoluol, $C_7H_6(NO_2)_2$; metaiodtoluol, C_7H_7I; solid iodnitrotoluol, $C_7H_6(NO_2)I$; chlorotoluidine, $C_7H_6ClH_2N$.

Contributions from the Technical Laboratory of the University of Kasan (Russia).—A. Saytzeff.—This paper is divided into the following sections:—On amyl-ethyl-sulphide; action of zinc-sodium alloy upon a mixture of anhydrous acetic acid and iodide of alcohol (*alcohol jodur*); action of pentabromide of phosphorus upon bromacetyle; a new method for the conversion of fatty acids into the corresponding alcohols; synthesis of normal butylic alcohol; synthesis of alcohol (*Weingeist*); synthesis of normal propylic alcohol; on the proportion of oxygen combining with some of the organic derivatives of bivalent (*zweiwerthig*) sulphur; and on the behaviour of iodide of ethyl towards ethyl-bisulphide.

Action of Ammoniacal Salts upon Oxide of Copper.—J. Tuttschew.—When finely-powdered black oxide of copper, obtained by the ignition of nitrate of copper, is boiled with a solution of chloride of ammonium for a length of time, the oxide loses its colour and becomes greenish; when, after continued boiling, the mixture is evaporated to dryness, and next exhausted with water, a green powder and a bright blue-coloured solution is obtained. This powder, after having been well washed and dried, first at the ordinary temperature of the air, and lastly in the air-bath at between 120° and 140°, yields, on analysis, for 100 parts—Water, 17·02; chlorine, 16·10; oxide of copper, 70·05. The substance is, therefore, almost exactly similar to the mineral known as atakamite, from Copiapo, Chili, which, according to Dr. Rammelsberg's analysis is—

$$2(CuCl+3CuO)+9HO;$$

in 100 parts—Chlorine, 15·65; water, 17·88; oxide of copper, 70·00. When the oxide of copper is similarly treated with a solution of sulphate of ammonia, a salt is obtained consisting, in 100 parts, of—Oxide of copper, 67·87; sulphuric acid, 18·73; water, 13·40. Or a substance very similar to the mineral brochantite, from Krisuwaga, Iceland, consisting, in 100 parts, of—Oxide of copper, 67·75; sulphuric acid, 18·88; water, 12·18. With a solution of carbonate of ammonia, which, by-the-by, is itself decomposed by boiling, a substance was obtained containing, in 100 parts—Carbonic acid, 19·02; oxide of copper, 70·24; water, 10·74. With nitrate of ammonia, a substance is obtained containing, in 100 parts—Oxide of copper, 65·54; water, 18·94; nitric acid (N_2O_5), 15·52; or very nearly the substance, $2(6CuONO_5)+15HO$.

No. 5, 1870.

This number contains the following original papers:—

On M. Wyrouboff's Critical Remarks concerning the Labours of M. Reindel.—This paper contains the following sections:—Decomposition of ferrocyanide, by means of nitrate of soda, by crystallo-chemical reaction; action of chloride of copper on ferrocyanide of potassium. It is not possible to make any useful abstract of this paper.

Adulteration of Rice Meal.—A. D. van Bastelaer.—According to the author, properly-prepared macerated solutions of flour and meal of wheat, rye, barley, oats, Indian corn, buckwheat, peas, and beans, and linseed yield precipitates with concentrated solutions of picric acid. A reaction, due, in all probability, to the action of picric acid upon the albuminous compounds of these substances, which are hardly at all present in rice; and hence the fact that the meal of that cereal yields no precipitate with the reagent alluded to. The method of testing is executed as follows:—20 grms. of the flour to be tested, previously well freed from bran and husk,

is mixed with 100 grms. of cold water, and left standing with that fluid, at a temperature of 11° or 12°, for an hour, care being taken to stir the mixture frequently. The mass is next brought on to a filter and to the filtrate a cold saturated solution of picric acid is added; if this causes, in the case of rice-meal, a precipitate, one may be sure that substance has been adultrated with other meals. The meal obtained from ergot of rye also yields, with picric acid, a precipitate, if treated as above described.

Property of Amorphous Silicic Acid of Absorbing Moisture from the Air.—A. Souchay.—The author states that Dr. Lippert, while assistant to Professor R. Fresenius, made the observation that amorphous silica, after having been strongly ignited in a platinum crucible, attracted moisture from the air to a large extent; in consequence whereof, and to test this fact precisely, the author instituted a series of experiments, from which the following results are drawn:—Amorphous silica is always hygroscopic after ignition; the degree of hygroscopicity differs greatly, according to the degree of heat the silica has been ignited—so that feebly-ignited silica is far more hygroscopic than when strongly ignited. When silica has been only feebly ignited, its avidity for the absorption of water, even after the lapse of a few minutes, is so great as to cause, if not taken into account, serious faults in the weighing and quantitative estimation of that substance. Crystalline silica, even when feebly ignited, is not at all hygroscopic.

Les Mondes, March 24, 1870.

Meteorological Observatory at Montsouris.—To this institution, established by M. C. Sainte-Claire Deville, a grant of £2,400 has been made by the French Minister of Public Instruction for the current year, with the arrangement that the peculiar work to be done has to comprise—(1) The complete study of all the facts relating to the climate of Paris, and the observation of the phenomena of physical interest pertaining thereto; (2) the calculation and digestion of the older observations on record; (3) the collection and redaction of the daily observations made in France and abroad, as far as they are published or transmitted daily by telegraph; (4) the daily publishing of all the results of observations made.

Technical Education and Instruction.—By decree of the 19th inst., His Majesty the Emperor of the French has, upon the proposition of the Minister for Agriculture and Commerce, approved of the establishment, under the said Minister, of a superior council of technical education, a permanent committee of thirty-two members to be chosen from among the Legislative Assembly, the higher public instruction (professors of universities), the Imperial Conservatory of Arts and Works, the Committee of Arts and Manufactures, the heads of great industrial establishments, the free public instruction, and the Administration (Préfets, Maires, &c.). A sum of £20,000 has been granted to the Minister aforesaid, for the purpose of encouraging technical education; and the committee just alluded to will have to aid and advise the Minister and other parties in the carrying out of a good and useful technical instruction.

A New Aspirator.—Dr. Bleekrode.—This paper is illustrated with a woodcut, absolutely required for the description of a very useful piece of apparatus, which can be readily made with the ordinary appliances at hand in any laboratory, and is so contrived as to admit of permanent action if desired.

Cosmos, March 26, 1870.

Relation between the Variations of the Barometer and those of the Thermometer.—H. H. Hildebrandsson.—A meteorological paper of some importance.

Origin of Petroleum.—V. Meunier.—Three theories exist on this subject, viz.—That the petroleum is the result of the distillation of coal situated within reach of sources of heat of volcanic origin; that it is the result of a peculiar decomposition of substances of animal and vegetable origin; and that petroleum owes its origin to volcanic emanations condensed by pressure and cooling of the superincumbent layers of rock and earths. According (says the author) to researches recently made, it is probable that, since there undoubtedly exists some relation between the deposits of sulphur, petroleum, and rock-salt, the origin of petroleum is due to volcanic agency.

Intended Journey of Russian Scientific Men to the Western Portion of Europe.—A committee of the following gentlemen are preparing for a journey through Germany, France, the United Kingdom, and other parts of Europe, for the purpose of studying the progress made by science in all its branches in Western Europe:—Profs. Chrouszcrewsky, Kowalewsky, and Hibel, of Kiew University; the Grand Master of Dorpat University, Dr. M. Kepen; Profs. Prachoff and Baranieck, of St. Petersburg University; Prof. Sobler, of Moscow University; Profs. Wladimiroff and Kolosoff, of Charkoff University; Dr. Brandt, of St. Petersburg, and Dr. He, of Kasan University.

Zeitschrift für Analytische Chemie, Nos. 3 and 4, 1869.

The publisher of this periodical informs us that a strike of long duration among compositors and pressmen in a portion of Central Germany has caused a delay of several months in the issuing of this periodical, of which the two numbers now before us (a volume of some 300 pages) contain the following original memoirs and papers:—

Collocation of the Specific Gravities of Aqueous Solutions.—Dr. G. T. Gerlach.—This very useful tabulated form is arranged in the following manner:—At the top of the pages, divided into nine columns, we find, under the figures A, B, C, &c., to I, inclusive—The chemical formula and the equivalent of the substance in solution, in anhydrous as well as in hydrated or crystallo-hydrated state; quantities by weight of the hydrated substance contained in 100 parts of the solution; quantities by weight of the anhydrous substance in 100 parts of the solution; atoms of the anhydrous salt + 100 parts of water by weight; relative volume (bulk) of the solutions, taking the 100 parts by weight of water used for solution = 100 volumes; specific gravity of the solution; volumetrical degrees according to Gay-Lussac; name of the experimenter; temperature, and quotation of the book or periodical where the results here collected have been origionally published. As regards the substances here named, they are—Caustic ammonia; caustic potassa and soda; the carbonates of the two last-named bases; chloride of ammonia; chloride of potassium; chloride of sodium; chloride of aluminum; chloride of magnesium; chloride of calcium; chloride of strontium; chloride of barium; chloride of cadmium; chloride of zinc; chloride of tin ($SnCl_2$); perchloride of tin; the bromides of potassium, sodium, lithium, magnesium, calcium, strontium, barium, cadmium, zinc; the iodides of potassium, sodium, lithium, magnesium, calcium, strontium, barium, cadmium, zinc; hyposulphites of soda; the sulphates of ammonia, potassa, soda; protoxide of manganese; protoxide of iron; protoxide of iron and ammonia; sulphates of magnesia and potassa ($KO.SO_3+MgOSO_3+6HO$; sulphate of zinc; of copper; neutral and bichromate of potassa; neutral phosphate of soda; basic phosphate of soda; neutral arseniate of soda, $2NaOHO+AsO_5+24HO$; basic arseniate of soda, $3NaO\ AsO_5+24HO$; the nitrates of potassa, soda, magnesia, strontia, baryta; oxide of lead; chlorate of potassa; bromates of potassa and soda; iodates of potassa and soda; ferrocyanide of potassium and ferricyanide of potassium; neutral acetate of lead; neutral tartrate of potassa (KO.T); neutral tartrate of soda; tartarus natronatus; tartrate of potassa and soda; hydrochloric acid (ClH); sulphuric acid; sulphurous acid; phosphoric acid; arsenic acid; nitric acid; acetic acid; tartaric acid; citric acid. The paper further contains the

following sections :—The legal (gesetzmässig) continuation of the specific gravities of equally-concentrated solutions; changes of bulk, which take place during the solution of salts; changes of bulk which take place when aqueous solutions of salts are diluted with water; changes of bulk which take place when different solutions of salts are mixed. There follows next a series of tabulated forms, containing—(1) The specific gravities of almost all hitherto investigated aqueous solutions of salts, of caustic alkalies, of acids, and of sugar and alcohol. We cannot enter into more details, but should think that, since the portion of text to be translated is very small, these tables might be very usefully published in English in a separate volume, since the collection is highly useful, not only to scientific men, but also to very many manufacturers.

Contribution to the Means of Detecting, and Characteristic Reactions of, Citric Acid.—H. Kæmmerer.—Since the value of this paper rests entirely upon the woodcuts annexed thereto, representing microscopically-observed substances, we cannot enter into any further details.

Reciprocal Method of Calculating Atomic Formulæ, and especially those of Silicates.—Dr. Mohr.—This paper cannot be read without the re-production of a series of tabulated forms belonging to it.

Contribution to the Methods of Analysing Mineral-Water.—Dr. Mohr.—A short paper. Reserved for full translation.

On R. Wagner's Chlorometrical Method.—Dr. Mohr.—A reply to Dr. R. Wagner, who thinks that the author's criticisms on his (Wagner's) method, as published by the author in his celebrated work on volumetrical analysis, are based on erroneous views.

Analysis of Manganese.—Dr. Mohr.—A short but valuable paper. Reserved for full translation.

Presence of Peroxide of Hydrogen in Air.—H. Struve.—The chief results contained in this paper are—(1) Peroxide of hydrogen is formed in the air simultaneously with ozone and nitrate of ammonia, and is condensed in the meteoric waters; (2) peroxide of hydrogen, ozone, and nitrate of ammonia, are intimately connected together; (3) the change which the so-called ozone-paper undergoes when exposed to air is due to the joint action of ozone and peroxide of hydrogen; peroxide of hydrogen does not decompose solution of iodide of potassium with separation of free iodine; (5) free carbonic acid decomposes the solution of iodide of potassium, causing the formation of carbonate of potassia and free hydriodic acid; (6) when the peroxide of hydrogen is present along with carbonic acid (acting as just alluded to), iodine is separated; (7) the best and most effective reagent for the detection of small traces of peroxide of hydrogen is oxide of lead, since puce-coloured peroxide is formed. The author describes at great length the reactions and the proper application of the same.

Comptes Rendus des Séances de l'Académie des Sciences, March 28, 1870.

This number contains the following papers relating to chemistry and physical sciences :—

Application of an Electric Current in Calorimetry.—J. Jamin, this paper is divided into the following sections :—Application in the case of solids and liquids; gases and vapours; latent heat; the two specific heats.

Specific Heat of Water between 0° and 100°.—J. Jamin and A. Amaury.—An algebraico-physical paper, containing a very large number of tabulated results, in figures. There is annexed to this paper another, by V. Regnault, containing a series of observations and remarks on the contents of the essay of the authors.

On Trichlorhydrine and Substances Isomeric therewith.—J. Berthelot.—The chief leading points of this lengthy paper are that hitherto no trichlorhydrine has been prepared, except by the aid of substances derived from glycerine. There exist, moreover, at the very least, five bodies isomeric with trichlorhydrine, viz. :—(1) The chlorinated derivatives from the hydride of propylen C_6H_8, including, in all probability, those of the normal propyl chlorhydric ether; (2) the derivatives from the chlorhydrate of propylen, $C_6H_8.HCl$, or the isopropyl-chlorhydric ether; (3) the derivatives from the normal chloride of propylen, $C_6H_6.Cl_2$, corresponding to the chloride of ethylen and diatomic alcohol; (4) the derivatives from dichlorhydric aceton; (5) the derivatives from trichlorhydrine, $C_6H_5.Cl_3$, corresponding to glycerine—that is to say, a normal triatomic alcohol.

Supersaturation of Chloride of Calcium.—E. Lefebvre.—This paper is an excellent contribution to the study of the phenomena presented by some saline solutions under various circumstances. The author first alludes to the well-known phenomenon presented by solutions of sulphate of soda, under certain conditions, which crystallise instantaneously. Solutions of chloride of calcium, and of the chlorides of strontium and barium, exhibit, if properly concentrated, the same sudden crystallisation; and the contents of this paper record the results of the author's extensive researches on this subject.

Chemical Research on Eucalyptol.—S. Cloëz.—The tree known by the name of *Eucalyptus globulus*, a native of Tasmania (where this specie was discovered, in 1792 by M. Labillardière) has been successfully acclimatised in the southern parts of France and other parts of Southern Europe. The author has discovered, in the leaves of that tree, a substance which he has named eucalyptol, a liquid specifically lighter than water, viz.—0·905 at 8°. Eucalyptol is difficulty soluble in water, but easily soluble in alcohol; this solution, when very dilute, has an odour analogous to that of roses. The formula of this substance is $C_{24}H_{20}O_2$; its vapour density, 6·22. Treated with anhydrous phosphoric acid, eucalyptol yields eucalypten, $C_{24}H_{16}$. The quantity of eucalyptol contained in the leaves of this tree, which, by-the-by, is, like the other eucalyptus species, remarkable on account of growing to heights of 80 and 100 metres, varies from 2·75 to 6 per cent.

Zeitschrift für Analytische Chemie, Nos. 3 and 4, 1869 (continued).

Contribution to the Knowledge of the so-called Nitrate of Iron of Commerce.—E. Lenssen.—Under the above name, there is met with in commerce an oily fluid of a blackish brown colour, and generally as heavy as 50° Baumé (1·525 sp. gr.); it tastes rather astringent, while it gives off a smell of nitrous acid; it is used very largely in dyeing and printing. The author has analysed several different samples of this material and gives the following three analysis as instances of what is sold (on the continent) for nitrate of iron. Sample marked N contained, in 100 parts—Peroxide of iron, 18·8; protoxide of iron, 0·4; sulphuric acid, 23·3; hydrochloric acid, 0·0; water, 56·6 = when formulated and in percentages—Fe_2Cl_3, 1·3; FeO,SO_3, 0·8; $Fe_2O_3.3SO_3$, 22·9; $Fe_2O_3,2SO_3$, 18·2; water, 56·8. Sample marked L contained, in 100 parts—Peroxide of iron, 20·10; sulphuric acid, 19·74; hydrochloric acid, 3·96; nitric acid, 2·18; water, 54·02 = formulated and percentically—Fe_2Cl_3, 5·86; $Fe_2O_3,3NO_5$, 3·25; $Fe_2O_3,3SO_3$, 17·95; Fe_2O_3, $2SO_3$, 17·94; HO, 55·0. Sample marked T—Peroxide of iron, 18·04; sulphuric acid, 21·69; hydrochloric acid, 1·68; nitric acid, 1·12; water, 54·47 = Fe_2Cl_3, 2·50; $Fe_2O_3,3NO_5$, 1·67; $Fe_2O_3,3SO_3$, 27·15; $Fe_2O_3,2SO_3$, 10·80; water, 57·88. The sp. gr. of all these samples was exactly 1·525. This lengthy paper contains, further, very valuable information on the use, the best mode of manufacture, and the best methods of analysis and practical assay of this material,

which is especially used to increase the weight of silk when that material is to be dyed black or blue of certain shades.

Methods of Research in Water Statistics.—Dr. H. Trommsdorff.—Under this title, the author gives a treatise on water analysis, divided into the following sections:—Hydrotimetry, description of the apparatus for measuring and preparation of the titrated soap solution; estimation of total hardness; estimation of the carbonate and sulphate of lime, of the magnesia salts, and of the free carbonic acid; estimation of the permanent hardness; estimation of the magnesia salts; description of the hydrometrical method of the estimation of the total sulphates; estimation of chlorine; estimation of organic substances; general preliminaries; preparation of volumetrical solutions; description of the application of these solutions; estimation of ammonia; colorimetrical estimation of ammonia; preparation of Nessler's test, and of a standard solution of chloride of ammonium; estimation of nitrous acid; estimation of nitric acid.

Precipitation and Estimation of Manganese by Hydrosulphuret of Ammonium.—Dr. A. Classen.—This paper is a lengthy series of tabulated results of volumetrical experiments made under the following headings:—Behaviour of mono-hydrosulphuret of ammonium with a solution of manganese in the presence of chloride of ammonium; behaviour of poly-hydrosulphuret of ammonium solution with a precisely similar solution; behaviour of mono-hydrosulphuret of ammonium containing free ammonia with a precisely similar solution of manganese; behaviour of poly-hydrosulphuret of ammonium containing free ammonia with a solution of manganese containing chloride of ammonium; behaviour of mono-hydrosulphuret of ammonium with a solution of manganese containing variable quantities of chloride of ammonium and free ammonia; behaviour of poly-hydrosulphuret of ammonium with manganese solutions as foregoing.

Utilisation of the Liquids containing Molybdic Acid from the Residues of Phosphoric Acid Estimation.—Dr. F. Muck.—The acid liquors, the filtrates from the yellow precipitate, are mixed with the ammoniacal wash-waters from the ammonio-phosphate of magnesia precipitates, and in addition, there is added phosphate of soda solution, in the proportion of 1 part of phosphoric acid to 30 of molybdic acid; after which, the fluid is left at rest for twenty-four hours in a warm place. The precipitate is collected on a filter and washed, until the filtrate begins to run slightly turbid; the precipitate is next dried in a water-bath, and next dissolved in ammonia (360 parts to 100 of precipitate) and this solution is poured into nitric acid (1350 parts) into which, previously, from 2 to 3 parts of pure magnesia have been dissolved. The ensuing precipitate of ammoniacal phosphate of magnesia is next removed; and, after having been standing for some time, in order to give time for a small quantity of phosphate of molybdenum to settle down, the solution is fit for use again as molybdate of ammonia.

Concentrated Sulphuric Acid, a Test for Molybdic Acid.—Dr. Schönn.—When molybdic acid, or the ammonia, soda, lead, or baryta salts of that acid are heated in a porcelain capsule, with just sufficient sulphuric acid to moisten the material, of which only a few small bits (less than two milligrms.) suffice for the experiment, there will be observed the appearance of a blue, ultramarine-like colouration, which disappears again when the sulphuric acid is evaporated. When quantities of 10 milligrms. and upwards are acted upon, the blue colour is evidenced, even at the ordinary temperature, but it is best to add a few drops of alcohol. A solution of molybdic acid has to be first evaporated to dryness, and the native sulphide of molybdenum must be first converted into molybdic acid, before this most sensitive test can be applied; neither titanic, tungstic, or vanadic acid exhibit this phenomenon when similarly treated with sulphuric acid.

Fusion of Substances with Sodium or Potassium.—Dr. Schönn.—A lengthy paper on some methods of fusion and ignition whereby sodium (being the cheapest) is applied to disintegrate and decompose, at a high temperature, various substances. We regret that the paper is not suited for useful abstraction.

Estimation of Uranium.—Dr. C. Winkler.—The author reviews and criticises Patera's labours on this subject, and chiefly points out some mistakes made in his calculations, as published in a former volume of this periodical.

Direct Estimation of Valerianic Acid in Valerianates.—A. Zavatti and F. Sestini.—Since the method of quantitative estimation here proposed and described is acknowledged and admitted by the authors to be invariably attended with a loss of at least 6 per cent of the substance to be estimated, we need not enter into details on this subject.

Phenylate of Potassa as a Test for the Presence of Water in Ether.—J. Romei.—Perfectly dry phenylate of potassa is quite insoluble in anhydrous ether, but partly dissolves in that liquid when containing water, and then imparts to it a reddish brown colour. The author found that, even when the ether contains only 2·5 parts of water in 1000 of ether, the test is perfectly perceptible.

Reduction of Small Weights.—Dr. K. L. Bauer.—An algebraical essay.

Composition of Atmospheric Air at Various Heights.—Dr. K. L. Bauer.—This paper contains a series of cypher figures derived from a formula (algebraic) as given by V. Regnault.

Behaviour of Sodium and Magnesium with Substances, and especially Liquids, which contain Sulphur.—Dr. Schoun.—After briefly referring to a former paper on this subject, the author now states that, instead of sodium, pulverised magnesium can be used for the detection of sulphur, in the following manner:—The substances to be tested (for instance, the sulphates of lime or baryta) are thoroughly mixed, previously reduced to powder, and next heated to redness with the metal in a test-tube made of thin hard glass. After the reaction is over, the contents of the tube are, when quite cold, treated with distilled water and tested with nitro prusside of sodium; organic substances—*e.g.*, previously-carbonised albumen—may be tested in the same manner for sulphur. As regards liquids containing sulphur, the author states that a drop of sulphuric acid, when brought into contact with sodium, yields, among the products of the reaction, sulphuret of sodium; with magnesium, this reaction does not take place unless heat be applied. Sulphide of carbon and essential oil of mustard may be readily proved to contain sulphur by application of the same test.

Very Simply-Constructed Small Sulphuretted Hydrogen Gas Apparatus.—G. Hinrichs.—Illustrated with a woodcut essentially necessary for the proper understanding of the description.

Quantitative Estimation of Carbon in Pig-Iron.—Dr. R. Fresenius.—The weighed quantity of iron to be tested for carbon is placed on a small porcelain boat and introduced into a hard glass combustion-tube, placed in a combustion-furnace, and, when red-hot, a current of dry chlorine gas (dried by making it pass over pieces of pumice-stone moistened with strong sulphuric acid) is passed over; the current of gas and application of a low red heat is continued until all the iron is volatilised as chloride. The carbon left in the small boat is, after the apparatus has cooled, placed in a porcelain tube and burned. After being heated to redness in a current of oxygen, the products of the composition are taken up by Liebig's potash-bulbs. Great care is required that the chlorine be thoroughly dry, since, otherwise, hydrocarbons may be formed and some carbon lost.

Behaviour of the Vapours of Nitrous and Hyponitric Acid when Daylight passes through them.—Dr. E. Luck.—This paper contains a series of observations on the spectra exhibited by these substances.

Absorption-Spectrum of Perchloride of Manganese (Mn_2Cl_7).—Dr. E. Luck.

Behaviour of Hypochloric Acid with Brucine and its Salts, and on the Value of the Reaction of Brucine for Detecting Small Quantities of Nitric Acid.—Dr. E. Luck.—The main point of interest of this paper is the fact that, when brucine comes into contact with hypochloric acid and free sulphuric acid, there appears a highly-red colouration, which disappears on the addition of tin-salt. The use of brucine for the detection of nitric acid is, according to the author's researches, not very reliable, and less distinct than the reaction of phenol-sulphuric acid with nitric acid.

Solubility of Cream of Tartar (Bitartrate of Potassa) in Aqueous and Alcoholic Fluids; Testing of the Berthelot Fleurieu Method for the Quantitative Estimation of that Salt, and of Tartaric Acid, in Wine.—E. Kissel.—This lengthy paper, and the following—

Estimation of Acetic Acid in Wine—E Kissel—Are too extensive for useful abstraction, and, moreover, chiefly interesting in vine-growing and wine-producing countries.

Composition of the Carbonates of Manganese.—E. Prior.—The author describes, at very great length, a series of experiments in order to elucidate the real composition of carbonate of manganese, prepared in different ways and with pure materials, and with precautions as regards its alteration by oxidation. The precipitate produced in a solution of pure and neutral sulphate of manganese by the addition of carbonate of ammonia is, after very careful drying *in vacuum*, composed, in 100 parts, of—MnO, 57·25; CO_2, 35·48; HO, 7·27. Formula, $2(MnO,CO_2)+HO$. The precipitate produced by carbonate of soda in solutions of salts of protoxide of manganese is composed, in 100 parts, of—MnO, 61·73; CO_2, 38·27. The precipitate, however, of carbonate of manganese, as usually obtained by precipitating a proto-salt of that metal with carbonate of soda, was found to consist, after drying at 60°, in 100 parts, of—MnO, 62·11; CO_2, 37·89.

Action of Boiling Saline and other Solutions upon Vessels of Glass and Porcelain.—W. Casselman.—This very lengthy paper contains the results of an extensive series of experiments, from which the following general results are derived:—Water and acids hardly, if at all, act upon good porcelain vessels; the fixed alkalies attack porcelain, but less so than they do glass, which is far more readily and generally acted upon by the substances alluded to, as well as by saline solutions.

Journal de Pharmacie et de Chimie, March, 1870.

This number contains the following original papers and memoirs:—

Two Products of the Boletus Laricis, a kind of Mushroom.—G. Fleury.—The author has separated from this, previously dried and pulverised, cryptogamic plant, a resinous substance, insoluble in water; soluble in ether, absolute alcohol, chloroform, and acetic acid; insoluble in benzol and sulphide of carbon; and fusing at 89·7°. Caustic potassa solution and ammonia take up this body, yielding solutions which froth very strongly. This resin consists, in 100 parts, of—Carbon, 71·6; hydrogen, 9·6; oxygen, 18·8; its barium compound is $C_{61}H_{88}BaO_{11}$. Agaricic acid, a white crystalline body, fusing at 145·7, soluble in alcohol, but hardly soluble in water or ether. Percentage composition—Carbon, 64·0; hydrogen, 9·3; oxygen, 26·7.

Preparation and Properties of Hydrate of Chloral.—J. Personne, and—

Report on Some Facts relating to the History of the Hydrate of Chloral.—MM. Roucher, Lebaigue, and Jungfleisch—Are, although valuable, strictly pharmaceutical papers.

Search for Cyanhydric Acid in Tobacco Smoke.—Drs. Poggiale and Marty.—Since Dr. Vogel, in Germany, had stated that he had very readily detected cyanhydric acid in tobacco smoke, by means of Schoenbein's test-paper for that acid, the authors have very carefully conducted a series of experiments, by means of aspirators, with tobacco (200 grms. at a time) placed in the bowl of a large pipe, and have tested the smoke, as well as the tarry and oily products of the combustion of tobacco, with the following results:—Tobacco smoke does not contain any hydrocyanic acid; neither is any found in the other (condensed) products of the combustion of tobacco. The authors also state that Schoenbein's prepared paper for the detection of cyanhydric acid is not reliable for that purpose; while they have applied proper tests, and compared these with fluids to which either cyanhydric acid or cyanides had been purposely added.

Les Mondes, March 31, 1870.

Decrease of the Temperature of the Air in relation to the Elevation above Sea Level.—Dr Hann.—This author has tried to solve, experimentally, or, rather, by observation, the problem of the decrease alluded to by comparing the average of temperature, as observed at certain groups of stations situated under the same mean latitude and longitude, and by taking into account local influences. Seven of these groups are situated in the western portion of the Alps, at from 230 to 3,330 metres above sea level; four in the northern part of Switzerland, at from 500 to 1780 metres above sea level; three in the Rauhe Alps (Wurtemberg), at from 310 to 810 metres above sea level: four in the Ezgebirge (Central Germany), at from 180 to 850 metres above sea level; and four in the Harz (province of Hanover and Brunswick), at from 70 to 1140 metres above sea level. The results obtained have proved that, in the instances mentioned, the decrease of the temperature of the atmosphere near to the ground is really proportionate to the height of the locality above sea level. When the results of all the observations are duly considered, there is discovered to exist a very strongly-marked annual periodicity, and a very uniform decrease of temperature from below to above, the average relation of the temperature reigning in December being, to that of June, as 1 to 2.

Bayerisches Industrie und Gewerbe Blatt, January and February, 1870.

These numbers contain, as usual, the full texts of a great number of official communications, chiefly of local importance, and, in addition thereto, the following papers relating to chemistry and collateral sciences:—

Supply and Quality of the Water Used for Domestic Purposes to the City of Munich.—Dr. A. Wagner.—It appears, from this paper, that the capital of Bavaria is exceedingly well off, both as regards the sources of supply, the quantity and quality of the water, which is very pure, containing, as it does, only from 0·16 to 0·60 grms. of solid matter (organic inclusive) to the litre of fluid.

Substitute for Copper for the Daniell Electric Battery.—Dr. C. Stölzel.—The author says—Take a piece of well-polished tin-plate (sheet tin, not tinned iron), immerse it in a very dilute solution of a copper salt, and put it in connection with a weak galvanic current. After the lapse of from fifteen to eighteen hours, a layer of strongly-adhering metallic copper will have become firmly deposited upon the tin-plate; and the latter, after having been bent into the required shape, is an excellent, cheap, and durable substitute for the copper cylinder in Daniell's battery.

Collieries near Miesbach, Upper Bavaria.—F Hailer.—An excellent monograph, from which it appears that, as far back as the year 1447, pit-coal was known, and in use (limited, however), in that district.

Alboliith.—W. Riemann.—Under this name, the author

prepares a cement chiefly consisting of magnesia. For this purpose, the magnesite of Frankenstein (Silesia) is ignited in retorts similar to those used for gas manufacture; and, after the mineral (a native carbonate of magnesia) has been ignited, it is mixed with silica and some other substances not specified. This mixture has the property of yielding, with moderately-concentrated solutions of chlorides (for instance, chloride of magnesium), a most extremely plastic, but, on drying, a very hard material, excellently adapted for use as cement for stucco and ornamental work, and instead of gypsum.

These numbers also contain the programme of a General Industrial Exhibition intended to be opened at Cassel (Prussia) in June next. The object of this Exhibition is very similar to that held at Amsterdam last year.

Journal für Gasbeleuchtung, February, 1870.

This number contains—

Regulations for the Inspection and Testing of Gas Meters for the Grand Dukedom of Oldenburg.

Collection of Facts relating to the Supply of Potable Water for Altenburg, Berlin, Zurich, and a large number of Cities and Towns of Germany, Austria, Hungary, and Northern Italy.

Polytechnisches Journal von Dingler, first number for February, 1870.

The number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

Thermometer and Pyrometer Provided with Automatical Electric Signalling Apparatus.—O. Zabel.—This paper is illustrated with a series of engravings absolutely required for the proper understanding of the useful contrivances herein described.

Combined Areometer.—Dr. H. Bardeleben.—This lengthy memoir, also illustrated with an engraving, describes an instrument—an ingenious combination of the scale and the weight areometer—whereby the determination of the specific gravities of solid bodies is rendered easily performed, while the instrument serves, at the same time, the purposes of the areometers in ordinary use.

Application of Gas to Blast Furnaces.—F. Lürmann.

On Rapakiwi as a Suitable Material of the Manufacture of Bottle-Glass.—H. G. Bennath.—The material known in Finland (a portion of the Russian Empire) as rapakiwi, and wrought in the quarries of Pyterlak, consists, in 100 parts, of—Silica, 74·24; alumina, 12·13; peroxide of iron, 2·88; lime, 0·90; magnesia, 0·19; potassa, 6·68; soda, 2·50; water, 0·04. The author describes, further in his paper, a series of experiments made with the view to ascertain the most suitable materials, and the quantities thereof, to be mixed with the mineral (a kind of granite used for building and ornamental purposes, especially in St. Petersburg) in order to form good glass.

Utilisation of Exhausted and Sliced-Up Beet-Roots as Fodder.—Dr. C. O. Tech.—This paper is chiefly interesting to beet-root sugar makers who apply the so-called Robert's method of juice extraction.

Second February number.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

Improved Pyrometer.—C. Bock.—To this paper and the following—

Control Thermometer—Th Oechelle—The engravings are required for the proper understanding of the subjects described.

Changes and Alterations Coal Undergoes by Exposure to Air.—Dr. E Richters.—We can only quote the titles of the different sections this highly-interesting paper has been divided into, viz.:—Chemical process of the oxidation of coals; influence of heat on the process of oxidation; influence of moisture upon the oxidation; influence of light upon this process.

Possibility of the Application of Gas to Blast Furnaces.—C. Schinz.

Bleaching of Wool.—Dr. H. Grothe.

Activity (Wirksamkeit) of Amorphous Phosphorus for Safety Matches.—W. Zettel.—A paper of special interest only to lucifer match makers.

Schlickeysen's System of Improving Peat.—R. Schmidt.

Coating of Brass with Bismuth.—C. Puscher.—Add to a solution of nitrate of bismuth, made with 16·66 grms. of that metal, 33·32 grms. of purified cream of tartar dissolved in boiling water, and add from 50 to about 67 grms. of previously-pulverised bismuth. Place the brass objects to be coated over into this fluid while boiling, and, in a short time, a brilliant silvery white strongly and firmly-adhesive coating of bismuth will be deposited.

Comptes Rendus des Séances de l'Académie des Sciences, April 4, 1870.

Leaving the purely mathematical, mathematico-physical, and similar papers, as also those belonging to natural history, unmentioned, this number contains the following papers relating to chemistry and collateral sciences:—

The Teacher of Descartes.—M. Jouglet.—The author has discovered, in the Municipal Library, at Tours, an unpublished manuscript bearing title, "In Universam Logicam Moralemque Philosophiam Commentarius Authore Celeberrimo Professore Grandillonio, ex convictu Flexensi," 1619. It is a well-known fact that Descartes (Cartesius) was educated at the College at La Flèche, but his teacher's name had not hitherto been found out. The author of this paper states that the manuscript is of great value, and deserves to be printed for public use.

Existence of Selenium in Commercial Copper.—Ch. Violette.—In order to detect the presence of this metalloid in copper, the author oxidises the metal, previously suitably cut up, by heating it to redness in a muffle. The oxide obtained is next placed in a combustion-tube, and then placed in a gas or other furnace (as applied for elementary organic analysis), and heated to strong red heat for several hours in a current of dry and pure air freed from aqueous vapour and carbonic acid. If any selenium be present, there will appear, at the cooler portion of the tube, just outside in front of the furnace, a white-coloured ring, composed of a volatile, crystalline, very hygrometric substance, readily soluble in water, and not coloured blue on addition of ammonia, which indicates absence of copper. The aqueous solution yields an abundant precipitate with nitrate of silver, which is soluble in excess of nitric acid. Reducing agents turn this white-coloured ring into a red-coloured substance, which exhibits all the reactions of selenium. The copper operated upon was from Chili.

Cause of the Acidity of the Water Collected in the Chloride of Calcium Bulbs Fixed to the Apparatus in Use for Elementary Organic Analysis.—Ch. Violette.—The author's researches prove that the acidity alluded to is due, partly to hydrochloric acid, and partly to selenious acid; the former being due to the omnipresence of hydrochloric acid in the air of chemical laboratories, and, as regards the latter, the cause has just been explained.

Formation of Formic Acid from Carbonic Acid.—E Royer.—The author states that, while submitting to the action of a current of electricity an aqueous solution of car-

bonic acid, the latter was simply, by the addition of hydrogen, converted into formic acid.

General Theory of Chemical Action.—M. Maumené.—Of this memoir, which was not read, the Perpetual Secretary on duty at the meeting said that it contained a critical review of the labours of MM. Friedel and Crafts on silicium-ethyl.

Laws which Regulate the Expansion of Gases.—J. Dubrunfaut.—One of the most prominent points of this lengthy paper is the statement made by the author that even the driest air, or any other gas, contains always 5-10.000ths part of a gramme of aqueous vapour to the litre.

Object-Glass Provided with a Prism to be Used with an Ophthalmoscope.—M. Wecker and G. Roger.—By the contrivance of a prism for total reflection, the authors enable two parties to make observations simultaneously.

Application of Polarised Light to the Photographing of Microscopically-Small Crystals of some Salts.—J. Girard.—There was no paper read on this subject, but the photograms were exhibited.

Newly-Published Work.—H. de Parville.—M. J. Dumas highly eulogises the volume just published under the title of "Causeries Scientifiques," (Scientific Gossip). The eminent author reviews the recently-made progress in divers branches of science, and the applications thereof.

Although not belonging to chemistry or collateral sciences, we quote the title of the following paper, chiefly because France is indebted to M. J. Dumas for instituting this very useful *enquête* while he (now some 20 years ago) was the Minister of Agriculture, Commerce, and Public Works.

Communication of the Cases of Rabies which have Occurred in France during the Sexennial Period, of 1863 to 1868 inclusive.—M. Bouley.

Revue des Cours Scientifiques de la France et de l'Etranger, April 2, 1870.

This number does not contain any original papers or memoirs relating to chemistry or collateral sciences.

Revue Hebdomadaire de Chimie, March 24, 1870.

Description of an Apparatus Suited for Heating Molasses.—Lefèvreef Levbre.—This apparatus, illustrated by a woodcut, the author states, is highly economical, in consequence of the very small consumption of fuel, and that this apparatus is now being introduced for the heating of wines ccording to Pasteur's system.

Refining of Raw Sugars, and Extraction of Crystallisable Sugars from Molasses, by means of the Sucrate of Hydrocarbonate of Lime.—MM. Boivin Loiseau.—This paper, although not a reproduction of another on the same subject, and already alluded to by us, partakes of the same defect, viz., of not lucidly and clearly describing the process, and of not in the least explaining what sucrate of hydrocarbonate of lime is, or how it is prepared.

New Process for the Preparation of Nitric Ether.—H. Lossen.—Nitric acid (sp. gr., 1·4) is heated with nitrate of urea (15 grms. to the litre) to boiling-point, and next left to become cold. 400 grms. of that acid are then taken and mixed with 300 grms. of absolute alcohol; and thereto is added 100 grms. of nitrate of urea, and this mixture distilled from a tubulated retort. When about half the contents of the retort have been distilled over, a fresh portion of alcohol and acid is added, by means of a proper funnel-tube. The 100 grms. of nitrate of urea are sufficient for obtaining 7 litres of this ether.

Moniteur Scientifique, No. 319, April 1, 1870.

This number contains the following original papers and memoirs relating to chemistry and allied sciences:—

Researches on the Ethers of Boracic Acid.*—H. Schiff.—This most extensive monograph is divided into the following sections, the titles of which we can only quote, since the work is not suited for any useful abstraction. In the introduction, the author discusses boracic acid, of which he assumes the existence of monoboric, biboric, triboric, tetraboric, and polyboric acids, illustrated by a series of complicated formulæ. We next have—Triethylic borate; monethylic borate; monethylic triborate; Ebelmen's boric ethers; methylic derivatives, of boric acid; amylic derivatives of boric acid; mixed ethers of boric acid; monomethylic borate; boric anhydride and glycerine; boric anhydride and phenic alcohol; monophenic borate; tetraphenic diborate; boric anilide; supposed combination of chloride of boron and ether.

Adulteration of Catechu.—J. Tissandier.—It is a well-known fact that catechu is too often adulterated; and the sophisticated substance has often injuriously affected various operations wherein it is employed, especially dyeing and calico-printing. According to this author, genuine catechu, when exhausted by means of ether, loses 53 per cent of its weight, leaving, after drying, 47 per cent of residue. A mixture of catechu and alum gives a white precipitate with nitric acid and with chloride or barium.

Neues Jahrbuch für Pharmacie, von Dr. F. Vorwerk, January, 1870.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

Estimation of the Value of the Various Kinds of Cinchona Bark.—Dr. A. E. Vogl.—Forty grms. of the previously-pulverised bark are intimately mixed with 10 grms. of quick-lime, and made into a thin paste with water; and this mixture is dried (the temperature is not stated). The dried mass is pulverised, and repeatedly exhausted with boiling alcohol at 90 per cent (600 c.c are a sufficient quantity for this purpose; the alcoholic solution is filtered, and to the filtrate are added about 5 c.c. of dilute sulphuric acid. The ensuing precipitate of gypsum having been removed by filtration, the alcoholic fluid is submitted to distillation, and, after having been greatly reduced in bulk, is further evaporated to a very small bulk on a water-bath, whereby, a flocculent, resinous, vanilla-like smelling aromatic substance is precipitated. After this material is again removed by filtration, to the filtrate is added a sufficient quantity of a solution of caustic soda as is required for the precipitation of all the alkaloids contained in the bark. These bodies are, by this mode of treatment, obtained in a high degree of purity in the shape of a white caseous, or crystallino-flocculent precipitate; this should be collected on a previously-tared filter, washed with the smallest possible quantity of water, and thoroughly dried, and next weighed. In order to separate the different bases from each ether, the aforesaid precipitate is digested for twenty-four hours in a small flask with about 5 c.c. of ether. The ethereal solution is filtered off from the insoluble residue, which is first washed with ether, and next dissolved in alcohol. Each of the solutions so obtained is evaporated, yielding, in some instances, an amorphous, in others, a crystalline residue. These residues are dissolved in dilute sulphuric acid; and, after these solutions have been filtered, the alkaloids are precipitated from these solutions by means of a caustic soda solution, which has been titrated so as to correspond with the dilute sulphuric acid applied as just stated. This method of the estimation of the value of the cinchona barks is recommended by the author for the reason—(1) that it is easily and rapidly executed; (2) because it affords complete exhaustion of the valuable constituents of the bark, with very little, if any, loss; (3) because the bases are obtained directly in a high degree of purity. There are appended to this paper a series of results of analyses of various kinds of barks, made partly by this

* This paper is not, in the strict sense, original, but, since it has been only published in the *Giornale di Scienze Naturale ed Economiche di Palermo* (vol. v., p. 9,) we quote it here.

and partly by other well-known methods, as devised by scientific men who, like Dr. D. Vrij, Dr. Rabourdin, and Prof. Schneider, are high authorities on this subject. From the results here published, this method deserves every praise.

On Arsenic-Free and Arsenic-Containing Aniline Colours.—Dr. Werner-Ertel.—The main gist of this paper, which contains some rather startling and curious, yet, unfortunately, not properly specified, statements, in respect of the extensive dissemination of arsenic in some of the German rivers, as a consequence of the large consumption of arsenic in the preparation of aniline colours, is, how to obtain fuchsine, and other similar preparations, free from arsenic, so as to render these substances fit for the colouring of sweetmeats, liqueurs, syrups, and pharmaceutical preparations.

Preparation and Qualitative Testing of Hydrate of Chloral.—Dr. Riecker.—A lengthy, but purely pharmaceutical paper.

Very Simple, but rather Rare, or Hitherto Undetected, Adulteration of Saffron.—Dr. W. Hallwachs.—The author states that, when he was, towards the end of last year, performing his duty as Inspector of Pharmacy and Pharmaceutical Chemists' Shops, he met with two instances of saffron having been adulterated with chalk; a fraud, he says, not so readily perceived as would appear, since it is only found out by taking a rather large quantity of the drug and placing it in water. Upon stirring the mixture, the chalk settles down on the bottom of the vessel, and may, of course, after having been washed with water, be readily tested. The author estimated the quantity in one instance, and found 17·5 per cent by weight; he also states that, in his opinion, this adulteration of this always rather expensive drug is made at the places where the saffron is grown, in order thus to increase the weight.

Decomposition of Ammonio-Phosphate of Magnesia.—Dr. N. Graeger.—The author states that he is in the habit of keeping a concentrated aqueous solution of this salt for the purpose of washing therewith the precipitate of the same salt obtained in well-known analytical operations. The aqueous solution alluded to, not having been required for use for at least six months, the author, on requiring it again, was astonished to find that, on the surface of the liquid, as well as on the layer of the salt at the bottom of the bottle, there was a film of pale golden-yellowish coloured substance; on opening the vessel which contained the solution, a very strong smell of phosphuretted hydrogen appeared. The quantity of the coloured material alluded to was too small to test even qualitatively, but the author thinks it might be phosphide of magnesium. The distilled water used for making the solution was pure, but not quite free from a small quantity of organic matter.

Annales de Chimie et de Physique, March, 1870.

This number contains the following original papers:—

Researches on Camphor, and on some of its Derivatives.—H. Baubigny.—Continuation and end of a very lengthy paper.

New Theory of the Electro-Dynamic Action.—M. Reynard.—An algebraico-physical essay.

Researches on the Combinations of Silicium with the Alcohol Radicals.—C. Friedel and J. M. Crafts.—This memoir is divided into the following sections:—Silicium-ethyl; oxide of silicium-triethyl; action of bromine on silicium-ethyl; action of bromine and iodine (jointly) on silicium-ethyl; action of iodine on silicium-ethyl; action of chlorine on silicium-ethyl; acetate of silicononyl; siliconylic alcohol; constitution of silicium-ethyl-bichloride; oxidation of silicium-ethyl; silicium-methyl; silicium-ethyl-methyl.

Experimental and Theoretical Researches on the Equilibrium Figure of a Liquid Mass which is considered as Devoid of Weight.—J. Plateau.—Conclusion of a very lengthy and abstruse, yet very valuable, paper on this subject.

Bulletin de l'Académie Impériale des Sciences de St. Petersbourg, vol. xiv., No. 4.

This number contains only one paper relating to chemistry—

Some of the Properties of Galvanically-Precipitated Iron.—R. Lenz.—This lengthy paper records a series of experiments, not only made with iron, but also copper. The results are stated as follows:—Iron and copper, when reduced to the metallic state by electricity, contain gases occluded, among which, hydrogen is in largest amount; the bulk of gas thus occluded varies considerably, but iron has been found by the author to occlude as much as 185 times its own bulk. The absorption of the gases is more considerable in the first layers of metal deposited. On being heated the iron loses gas, even below 100°, the gas evolved at so low a temperature being chiefly hydrogen. Iron which has been galvanically precipitated, and then made red-hot and cooled, becomes oxidised when put into water, that liquid being decomposed and hydrogen given off.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, No. 206, February, 1870.

This number is almost entirely filled with a lengthy report of the General Annual Meeting of this Society held on the 11th of February last, under the presidency of M. J. Dumas. Among the reports of the prizes and medals given to a very large number of parties, the following may be noticed as being of general importance:—

Distillation of Beet-Root in the Rural Districts, as carried out by M. Champonnois's System, to whom the Argenteuil Prize of £500 is given.—M. Heuzé.—This is an excellent paper on a rural industry now of very great importance, not only for the production of alcohol, but also for fodder for cattle and the supply of farmyard manure.

Pyro-Electric Gilding Invented by M. Massetotte, to whom a Prize of £20 has been given.—M. Barral.—From the author's report, it appears that this invention is very valuable, since it possesses all the advantages of the best method of mercurial gilding, without being at all detrimental to the workmen.

Improvements in the Methods of the Preparation of Extracts from Dye-Stuffs, by M. Corz, to whom a Gold Medal has been awarded.—This process is briefly alluded to, having been already fully described some three years ago. From what is here stated, the extracts prepared by this method are in high reputation at Mulhouse, Rouen, and Lyons.

Animal Phosphated and Chlorinated Manure.—A silver medal has been awarded to Dr. Groualle and Dr. Boucherie for having successfully solved the problem of utilising dead cattle—viz., dying a natural death, and converting the carcases, in a very short time, to an excellent manure—saving the fat, and obviating any nuisance.

Annalen der Physik und Chemie, von Poggendorff, No. 2. 1870.

This number contains the following original papers:—

Thermo-Chemical Researches.—J. Thomsen.—The fourth and final part of this monograph, subdivided into the following sections:—Boric acid; silicic acid; stannic acid; titanic acid: platinic acid (*platinsäure*); the fluorides of boron, silicium, titanium, tin, and platinum.

Circular Polarisation in some of the Six-Membered (Sechsgliedrigen) Hyposulphates.—C. Pape.

Some Peculiarities Relating to the Theory of the Capillary Phenomena.—J. Stahl.—A mathematico-physical essay.

[English Edition, Vol. XXI., No 542, page 179.]

On the Part Capillarity Plays in the Phenomena of the Spreading Out (Ausbreitung) of Liquids.—P. du Bois-Reymond.

Observations and Remarks upon Two Memoirs, by MM. von Bezold and E. Edlund, on Electrical Phenomena.—R. Clausius.

Historical Observation on the Publication of G. Magnus treating on the Reflection of Heat.—H. Knoblauch.

Relations Existing between the Changes of Bulk during the Formation of Solid Compounds and the Chemical Affinity of the Component Substances.—W. Müller.—Chiefly a series of tabulated forms, unsuited for any useful abstraction.

Preparation of Crystallised Silicic Acid by the Dry Way.—G. Rose.—The author records a series of experiments, chiefly of interest for mineralogy, as elucidating the formation of native crystalline silica.

Enstatite occurring in the Meteoric Iron of Breitenbach (Bohemia).—V. von Lang.—A purely crystallographical paper.

Crystalline Form of Hypersthene.—A. von Lang.—Also a crystallographical paper. Hypersthene is a mineral composed of silica, alumina, protoxide of iron, protoxide of manganese, magnesia, lime, and water.

Contribution to the Ozone Question.—O. Wolffenstein.—This essay is illustrated with engravings absolutely required for the proper understanding thereof.

Researches on the Compounds of Selenium and Sulphur.—A. Bettendorff and G. vom Rath.—This paper is chiefly a crystallographical essay respecting some compounds artificially obtained, the results of analysis of which are only approximatively given.

Electrical Action of Points (Spitzenwirkung).—Dr. J. C. Poggendorff.

Corroded Figures (Aetzfiguren) and Asterism in Iceland Spar.—Dr. H. Baumhauer.

Journal für Praktische Chemie, Nos. 22 and 23, 1869.

These numbers contain the following original papers and memoirs:—

Contribution to our Knowledge of Selenium.—Dr. B. Rathke.—This paper, a continuation of an essay on this subject, contains the following sections:—Estimation of selenium in organic compounds: carbide of selenium and selenium-xanthogenic acid; experiments for the preparation of selenium-tetrethyl and sulpho-tetrethyl; ethyl-selenious acid; observations concerning the organic derivatives of sulphurous and selenious acids, and also of sulphuric and selenic acids.

Ratanhine and its Combinations.—Dr. W. F. Gintl.—The commercial extract of rathannia contains a principle called ratanhine. The author, in the introduction to his paper, states that the substance known as angelin, and met with in the *Ferreira spectabilis*, is identical with ratanhine; and he has made use of that material (angelin) to prepare and analyse a lengthy series of compounds, among others, *ratanine ammonia*, no properly-speaking constant compound of ammonia; and the substance named could be obtained, and different formulæ are quoted relating to the higher or lower temperatures at which the *pro tempore* existing compound was prepared, 0° (32° F.). The formula is $C_{10}H_{12}NO_3+19NH_3$. Dry ratanhine does not combine with ammonia at all, if the latter be applied in the state of dry gas. There are further described a series of experiments to form compounds of ratanhine with the alkalies, soda and potassa, with baryta, strontia, lime, magnesia, and the oxides of heavier metals; the silver compound is $C_{10}H_{11}Ag_2NO_3$; behaviour of ratanhine with acids; and, lastly, speculative discussions on the constitution of ratanhine.

No. 1, 1870.

With this number begins a new series of volumes of this periodical which is edited by Dr. H. Kolbe. The number opens with a table of the numbers of the equivalents of the elements and some of their compounds, it being, of course, understood that the several authors who are contributors to this paper may make use of such equivalents as they prefer; but, unless the contrary is distinctly stated, the table here referred to is the one adopted for this periodical. We next meet with a very lengthy series of the titles and abbreviations thereof of the various scientific periodicals, as they will be quoted henceforward in this work. The present number opens with a lengthy essay on the—

Task and Scope of Mineral Chemistry.—H. Kolbe.—Not at all suited for abstraction.

Identity of Naturally-Occurring Leucine with that obtained by Synthetical Methods of Preparation.—Dr. G. Hüffner.—A physiologico-chemical paper, the leading point of which is that all the three known leucines, and obtained by different methods, are identical, and not simply isomeric.

Some of the Derivatives of Oxysulpho-Benzide.—J. Anoabeim.—This paper is divided into the following sections:—Ethyl-oxysulpho-benzide; nitro-ethyl-oxysulpho-benzide; tetra-chloroxysulpho benzide.

Isomeric Succinic Acids.—H. Byk.—A very lengthy monograph, too full of formulæ to admit of any useful abstraction.

Crystalline Forms of Trithionate and Seleno-Trithionate of Potassa.—B. Rathke.—A crystallographical paper, illustrated with woodcuts.

Bibliothèque Universelle et Revue Suisse.—Archives des Sciences Physiques et Naturelles, No. 147, 1870.

This number contains the two following original papers, of which, although not exactly belonging to chemistry, we quote the titles:—

Evaporation of Water of the Soil and of Plants.—E. Risler.

Dust Floating about in the Atmosphere.—A. de la Rive.

Cosmos, April 2, 1870.

Preparation of Photographic Figures on Glass.—E. Siegwart.—This paper contains a detailed account of the various operations required for fixing upon glass various designs.

Experiments on the Freezing of Wine.—A. Rousselle.—The reason why freezing improves wines, under certain conditions, is, according to this author, because, by freezing the proportion of all the fixed substances (*éléments*) in wine is increased, and these are, moreover, thereby rendered more fit for causing the combination of the acids with the alcohol, so as to form those ethers to which wine owes its peculiarly distinct flavour, aroma, and strength.

Revue Hebdomadaire de Chimie, March 31, 1870.

New Plan for the Method of Estimating the Market-Value of Molasses.—M. Mène.—This paper, chiefly of interest to beet-root sugar makers, enters, at some length, into the application of the areometer for ascertaining the value of the molasses; and next, the author discusses the plan of estimating the value of the molasses according to the alcohol it yields, stating that 100 parts of sugar should produce, in practice, 57 parts of alcohol at 90 per cent.

Description of an Improved Barometer for Use in Chemical Laboratories.—M. Alvergnat.—The description is not available without the woodcut; but the instrument is undoubtedly a very suitable one for the use it is intended for.

Annalen der Chemie und Pharmacie, February, 1870.

This number contains the following original papers and memoirs:—

On Fermentation, and on the Source of Muscular Force.—Dr. J. von Liebig.—The continuation and end of the celebrated author's lengthy essay on this subject, divided into the following main sections:—Acetic fermentation the source of muscular power.

Experimental Researches made with the view to Elucidate the Causes upon which the Substitution of the Radical Hydrogen is made Dependent in Isomeric Butyric Acids.—Dr. Morkowinikoff.—This very lengthy essay contains the following subdivisions:—Oxyisobutyric acid; researches on the different oxybutyric acids; the haloid hydrines of propylen-glycol.

Some of the Alcohols of Fermentation and Derivatives thereof.—J. Pierre and E. Puchot.—Not well suited for any useful abstraction.

Comptes Rendus des Séances de l'Académie des Sciences, April 11, 1870.

This rather small number is chiefly taken up by papers relating to phyto- and zoo-physiology. The papers and memoirs relating to chemistry and collateral sciences are the following:—

Correction of the Name of a Late Very Celebrated Man.—Marshal Vaillant deposits several authentic records, from which it appears that the famous natural-historian, Cuvier, was born on August 23, 1769, at Montbéliard, and his birth registered with the Christian names of Jean Léopold Nicolas Frédéric. The Christian name of Georges, by which, while living, this eminent man was known, is not on the official registers.

Action of Magnetism upon Two Electric Currents which are Made to Pass simultaneously through Space Containing Rarified Gases.—L. Daniel.

Experiments Made with the View to Elucidate the History of Nitric Acid.—E. Bourgoin.—The author's experiments, described at length, prove that by the reducing action of hydrogen upon nitric acid, $NO_5 2H_2O_2$, there are formed nitrous acid, deutoxide of nitrogen, nitrogen, and ammonia.

Metallic Tartrates.—M. Descamps.—The only tartrate described is the double tartrate of sesquioxide of manganese and potassa, $Mn_2O_3.KO,C_8H_4O_{10},4HO$ This salt is obtained by pouring a concentrated solution of bitartrate of potassa, at a temperature of 40°, upon sesquioxide, or, better yet, hydrated binoxide of manganese; the vessel wherein this operation is carried on should be cooled. The reaction results in the production of a deep red-coloured liquid, which deposits, after filtration and some days' standing, red coloured crystals of the double salt; the solution referred to is readily decomposed by the action of heat. Even at as low atemperature as 50° or 60° this decomposition begins, but at a higher temperature it becomes violent and instantaneous, being accompanied by a sudden evolution of oxygen; the liquid then becomes colourless and only contains a salt of the protoxide of manganese. The red-coloured solution is neither precipitated by caustic nor carbonated alkalies; all reducing agents decompose this solution, and the decomposition is accompanied by decolouration of the liquid.

Aurora Borealis.—This number contains a valuable series of communications concerning an aurora borealis, observed on the 5th of April in various parts of France and Belgium, over a surface of country stretching from the sea eastward to the Rhine, and from Louvain, Leuven (Belgium), in the north, to no less a distance south than Annecy, in Savoy, the latter being a distance about equal to that from London to Edinburgh.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 2, 1870.

This number contains the following original papers and memoirs:—

Zirconium.—B. Franz.—The author describes first at some length the preparation of pure zirconia on a somewhat large scale by treating the native mineral with bisulphate of potassa, and the decomposition of the sulphate of zirconia, first by fusion with caustic soda, and next by treating the fused mass so obtained with sulphuric acid, and precipitating the zirconia from the aqueous solution of the sulphate by means of ammonia. Metallic zirconium was prepared by the decomposition of the fluoride of potassium and zirconium, $3KFl + ZrFl_4$, by means of aluminium and a high temperature. The metallic zirconium so obtained is not quite pure, and was found to consist, in 100 parts, of:—Zirconium, 98·34; aluminium, 1·03; and silicium, 0·17. The temperature required for this reduction so as to obtain crystalline zirconium is as least as high as that of the melting-point of copper.

Expansion of Water (Lecture Experiment).—F. Rüdorff.—In order to exhibit the effect of the expansion of water when freezing, the author fills with distilled and previously well-boiled and cooled water a cast-iron cylinder having the following dimensions:—Height, 160 m.m.; diameter (external), 50 m.m.; thickness of solid iron, 15 m.m. After having been filled with water this apparatus is closed by means of a plug screwed into the neck, and the cylinder is next placed in a mixture of 3 parts of snow or pounded ice, and 1 part of common salt; after about 40 minutes the cylinder bursts with a loud report. It is essential for the success of this experiment that the plug fits very perfectly, and that the cylinder, after having been filled with water, be placed for some time in ice. The wooden pail which contains the cooling mixture should be rather roomy, and be covered with a stout towel to prevent the spirting about of the contents at the time of the bursting.

Preservation of Zoological and Anatomical Preparations in Creosote-Water.—F. Holbein.—The main point of interest in this paper is that specimens collected during journeys may, after having been kept immersed for a shorter or longer time in creosote-water to be made extempore, be dried and packed as if they were minerals.

Mesohydromellitic and Tetrahydrophthalic Acids.—A. Baeyer.—Mesohydromellitic acid is difficultly soluble in cold, but readily so in boiling, water; it is a solid crystalline substance; at 130° it loses two equivalents of water, and becomes anhydride of mesohydromellitic acid, $C_{12}H_2O_{10}$. Tetrahydrophthalic acid fuses at 95°; the author states that he is engaged in further researches on this subject. This paper contains a series of very complicate formulæ which serve to illustrate the constitution of the bodies alluded to, but space forbids us to re-produce these formulæ here.

Withdrawal of Water (Wasserentziehung), and its Bearing upon Vegetable Life and Fermentation.—A. Baeyer.—This lengthy paper is divided into the following main sections:—Anhydride formation; condensation; phenomena of fermentation.

Products obtained from Crude Malt Spirits by Distillation.—G. Krämer and A. Pinner.—The authors first refer to some former researches on this subject, reminding that raw or crude spirits (a rather strong alcohol is alluded to) contains large quantities of aldehyde acetal, and croton aldehyde; and they have further discovered, in the

so-called fusel oil, isobutyl alcohol, ethyl alcohol, and propyl alcohol.

Vapour Density of Acetic Acid.—A. Horstmann.—This paper is not suitable for abstraction. It contains a series of algebraic formulæ and tabulated results of the vapour density of the acid referred to from 12·4° to 63·1°.

Solid Bisulphide of Carbon.—Dr. V. Wartha.—Already referred to by us (See Chemical News, vol. xxi., p. 131; *American Reprint, May*, 1870, *page* 289).

New Locality where Diamonds have been Discovered.—G. Rose.—The author refers to the diamond found at Dlaschkowitz, a village in Bohemia. The facts are known to our readers from the abstracts from the *Comptes Rendus* for this year.

Cause of the Emission of Light by Phosphorus.—W. Müller.—This very lengthy memoir treats on the question, whether the emission of light by phosphorus is due to its oxidation, or whether it is caused by its volatilisation. A lengthy series of experiments is minutely described; and the main result arrived at is, that, since phosphorus is not oxidised by oxygen under normal conditions, and its emission of light increased by withdrawal of the pressure of air, it would appear that the luminosity of this substance is in some way connected with its volatilisation.

On Tetraphenol, C_4H_4O.—H. Limpricht.—This substance was obtained by the distillation of an intimate mixture of pyromucate of barium and 0·9 parts of soda lime. Tetraphenol is a colourless liquid, insoluble in water, boiling at 32°, and evaporating so rapidly at ordinary temperature, that a portion of a drop on a glass rod is solidified by the cold produced by the evaporation of the rest.

Use of Hypobromite of Baryta as a Reagent.—W. Knop.—This paper treats on the use of the hypobromite of baryta for the detection of ammonia, but the author's experiments on this subject are not quite complete as yet.

Cosmos, April 9, 1870.

Causes of Steam-Boiler Explosions.—J. Georges.—This author, a mechanical engineer and boiler-maker, states that his experience has taught him that the bursting and exploding of steam-boilers is chiefly due to defects in the iron plates used in the construction of these apparatus; and his proposal is, that, instead of testing boilers under pressure, as is usual, by means of hydraulic appliances, the plates should be tested at the iron-works, and stamped by the *garde-mine*, if found of sufficiently good quality for use for the construction of boilers. (The *garde-mine* is, in France, an official who might be termed, in English, a viewer of mines; but his education, practical as well as theoretical, is far more extensive, and under the Ingénieurs des Mines for each district; the supervision of stationary steam boilers, and of all manufactories connected with mining and metallurgical operations, is also confided to him.)

Laboratory Accident.—A short time ago, the inmates of the Hôtel-Dieu were greatly disturbed by a severe explosion, which shook the large building. On ascertaining the cause, it was found that the chemical laboratory of that establishment was the scene of the disaster; and among the heap of ruins into which this place was converted was found the almost lifeless body of a young student, who had repaired to the laboratory for making some preparation of oxygen (so the French text reads). As he was severely wounded and quite unconscious, the cause of the explosion has not been ascertained. As a matter of course the whole place was in flames also; but the *pompiers* on duty at the Hôtel de Ville succeeded in quenching the flames in a few minutes, by the aid of the hydrants in the building.

Imperial Agricultural College.—On the 1st of July next will be inaugurated another of these establishments, which have proved highly useful. The College here alluded to will be the first of the kind in the southern parts of France, and be established close to the city of Montpellier, where a site of some 25 hectares (about 62 acres) of land has been allotted for the purpose.

April 16, 1870.

Decimal System of Weights and Measures.—We learn that the two Representative Assemblies of the Kingdom of Wurtemberg have unanimously approved of the proposition made by the Ministry, as regards the adoption in that Kingdom of the decimal system of weights and measures, which becomes compulsory also for coinage from the first of January, 1872.

Nature of the Sun.—G. Bernaerts.—The first instalment of a rather lengthy, yet very interesting, paper on this matter, wherein is compiled all recent researches on this subject.

Increase of the Number of Inhabitants of Large Cities and Towns.—Although not belonging to the subjects generally treated in our paper, we may not omit to mention an astonishing fact. Leaving other particulars, we only quote that whereas, in the year 1832, Berlin was, in relation to the number of its inhabitants, the eighth in the order of the European capitals, it is now the third; its population in 1832 was 250,000, and in 1869 (end of year) it was 800,000, an increase at the rate of 220 per cent. Of all the capitals of Europe, the increase of population of Amsterdam during that time was the smallest, being only at the rate of 12 per cent. The next largest percentical increase to Berlin is that of Liverpool, at the rate of 174 per cent.

Les Mondes, April 7, 1870.

Foundation of a Chair of the History of Medicine and Surgery at the Medical Faculty of Paris.—Since authorisation has been received to accept the legacy of £6000 bequeathed by M. Salmon de Champoreau for the foundation of the chair above named, there will be shortly an election of a properly qualified lecturer for this office.

National Congress for Geographic, Cosmographic, and Commercial Sciences, at Antwerp.—During the month of August next, there will be a meeting at the city alluded to, and among the principal subjects for discussion are:—The astronomical past and future of our globe, its own heat and its cooling down; is it possible to draw, from the laws which rule these phenomena, conclusions relating to the economy of fuel, and to the influence which the hand of man has brought about by the draining of marsh-grounds and lakes, the cultivation of forest on mountains and plains, the formation of inland seas, &c.; adoption of the same *first* meridian; adoption of the same system of measures for use in daily life, as well as for scientific use; anthropology, in its relation to geography. Among the desirable works to be executed in the interest of all the civilized nations of the world, the congress desires discussion on the piercing of the Isthmus of Panama; railway towards Persia and India along the Euphrates valley, and conversion of the Desert of Sahara into an inland sea. There will be held at Antwerp, during the meeting, an exhibition of objects relating to geography, ethnography, and commerce.

Black Snow.—M. Feltz.—The author, who resides at Arlovetz, Russia, states that, during a severe gale of wind from the north-east, accompanied by a snow-storm, there fell, on the 31st of January last, between 2 and 4 p.m., a quantity of a blackish coloured substance, strongly contrasting with the peculiar brightness of the previously-fallen snow. On examining this powdery substance more particularly, it was ascertained to be arable soil, which, as was afterwards learnt, had been carried by the violence of the wind for a distance of many miles. The quantity of this soil, dried at 100°, was found to be 6·5 grms. for a surface of a square metre; and, since it was found that, at the very least,

a surface of 10 square kilometres (3·86 English square miles) had been covered to the same extent with this dust, the quantity thereof carried by the violence of the wind amounted to at least 650,000 kilos. = 650 tons' weight.

Foundation of a Laboratory for Medical Chemistry.—Dr. G. Le Bon.—In imitation of what has been successfully accomplished in Germany, the author has established a laboratory for the special purposes of testing, analysing, and experimenting in physiological and pathological chemistry, in connection with microscopical observations and other requirements of modern medical science.

April 14, 1870.

Cerebral Activity, and the Relation the Composition of Urine bears thereto.—Dr. Byasson.—According to a series of accurately-made experiments, the author having himself been the subject of such trial, he states that cerebral activity is accompanied by a more abundant production of urea, and alkaline phosphates and sulphates; while muscular activity is accompanied by the increased production of urea, uric acid, and chloride of sodium. The author's full researches are recorded in his inaugural thesis, sustained before the medical faculty at Montpellier.

Revue des Cours Scientifiques de la France et de l'Etranger, Nos. 19 and 20, 1870.

Neither of these numbers contain any original papers relating to chemistry; the last-named contains an excellent and full account of a lecture on the—

History and General Properties of Blood.—Claude Bernard.—This lengthy paper treats on this most important subject, commencing from the earliest days of existing written records, and fully entering into physiological as well as chemical details.

Annalen der Chemie und Pharmacie, March, 1870.

This number contains the following original papers and memoirs:—

Chemical Nature of the Xylol contained in Coal-Tar.—R. Fittig.—The gist of this very lengthy paper is that xylol, whether obtained from coal-tar or from other sources, is a mixture of various bodies.

On Isophthalic Acid and some of its Derivatives.—H. E. Storrs and R. Fittig.—The authors describe:—Isophthalic-acid ethyl ether—

$$C_6H_4\left\{\begin{matrix}CO(C_2H_5)\,O\\CO(C_2H_5)\,O\end{matrix}\right.;$$

Nitro-isophthalic acid—

$$C_6H_3(NO_2)\left\{\begin{matrix}COHO\\COHO\end{matrix}\right.;$$

Nitro-isophthalate of calcium and barium; nitro-isophthalic-acid ethyl ether, $C_6H_3(NO_2)O_4.(C_2H_5)_2$; amido-isophthalac-acid—

$$C_6H_3(NH_2)\left\{\begin{matrix}COHO\\COHO\end{matrix}\right.;$$

Hydrochloro-amido-isophthalic acid, $C_6H_3(NH_2)O_4.HCl + H_2O$; sulphuric-amido-isophthalic acid, $[C_6H_3(NH_2)O_4]_2H_2SO_4$.

On Amido-dicyanic Acid.—F. Hallwachs.—This memoir is divided into the following sections:—Preparation of amido-dicyanic acid; amido-dicyanate of silver, $C_2N_3H_2AgO$; amido-dicyanate of copper, $C_2N_3H_2CuO + 2H_2O$; and a series of other salts. The structural formula of amido-cyanic acid is—

$$O=C\left<\begin{matrix}NH\\NH\end{matrix}\right>C=NH.$$

On Sulpho-Cyanogen Compounds.—Dr. L. Glutz.—This lengthy essay, is divided into the following parts:—Behaviour of sulpho-cyanide of ethyl with concentrated hydriodic acid; derivatives of sulpho-cyanogen ethylen; rhodan ethylsulphinchloride.

On some of the Derivatives of Oxybenzole Acid.—Dr. A. K. Heintz.

On Ethyloxybenzole Acid.—G. Rosenthal.

On Thionessal, Tolallylsulphide, Lepiden, and Oxylepiden.—Dr. J. Dorn.

Synthesis of an Acid Homologous with Cinnamic Acid.—R. Fittig and P. Bieber.

On Molybdic Acid and Compounds thereof.—F. Ullick.—This paper, like all the foregoing of which the titles only are quoted, is an essay and monograph, and far too long for any useful abstraction.

Polytechnisches Journal von Dingler, first number for March, 1870.

This number contains the following original papers relating to chemistry and collateral sciences:—

Separator for Water and Steam.—C. von Witzleben.

Improved Evaporator for Saccharine Juices.—M. Schreiber.—Although the contents of these two papers, illustrated by diagrams do not exactly belong to chemistry, the contrivances described are so useful that we translate the titles.

Furnace for the Proper Combustion of Pulverulent and Wet Fuel.—A. Koch.—Illustrated with engravings.

Researches on the Coals of Upper Silesia (Prussia).—Dr. H. Fleck.—This very extensive and exhaustive monograph is a very valuable addition to our knowledge of coals, from a scientific as well as industrial and technical view of this subject.

Alterations Coal undergoes when Exposed to Air.—Dr. E. Richters.—A continuation of the former portion of this author's paper, containing the following sections:—On the causes of the spontaneous combustion of coals; difficultly-combustible coals; readily combustible coals. This paper is to be continued.

Estimation of the Average Size of Starch-Globules.—Dr. Schönn.

Method of Obtaining the Oxalic Acid contained in Madder.—M. Pernod.—When madder is converted into garancine, the oxalate of lime present naturally in madder is decomposed by the sulphuric acid. The oxalic acid thus set free was hitherto lost in the wash-waters; these fluids are now run into suitably-constructed tanks, and saturated with hydrate of lime, which causes the formation of a large quantity of precipitate of oxalate of lime. This salt is collected, and decomposed by sulphuric acid, carefully added, so as just to be sufficient for the combination of that acid with lime. The sulphate of lime is separated by filtration through flannel, and the solution of oxalic acid evaporated in leaden pans, re-crystallized, and fit for the market. The quantity of this acid thus obtained will vary according to the kind and quality of the madder; and it should be observed, also, that the Avignon madder, employed by the author, contains naturally a large quantity of lime—a base which greatly influences the formation of acids in plants in general, and oxalic acid especially.

Second Number for March, 1870.

This number contains the following original papers relating to chemistry and collateral sciences:—

Manufacture of Ice for Industrial Purposes.—Dr. R. Schmidt.—A paper chiefly treating on the cost of machinery and ingredients required for the making of ice for breweries and other places where it is required in large quantities.

Action of Sulphuretted Hydrogen upon Manganese Compounds.—A. Wagner.—The contents of this paper relate to a series of experiments made with the view to ascertain whether the hydrated oxide of manganese is preferable to hydrated peroxide of iron for the purpose of the gas-purification process. It appears, from the author's statements, that the iron preparation is in every respect to be preferred for this purpose.

Bleaching of Yarns and Woven Fabrics with the Permanganates of Potassa and Soda.—A. Pubetz.—The contents of this paper are only interesting to bleachers of linen and cotton materials.

Annales des Mines, No. 6, 1869.

This number contains the following original papers and memoirs:—

Mines and Metallurgical Manufactories of the Banat (a Portion of Hungary).—M. Castel.

Additional Notes to a Memoir on the Present State of the Metallurgy of Lead.—L. Grüner.

On some Minerals found in Chili.—M. Domeyko.—*Tungstate of Copper.*—In 100 parts:—Tungstic acid, 56·48; oxide of copper, 30·63; lime, 2·0; oxide of iron, 2·53; silica, 3·87; water driven off at red heat, 4·62. *On the Titaniferous Sand of the Chilian Sea-board, and on the Origin of that Sand.*—The analysis of two varieties of this sand is quoted percentically, care being taken to analyse separately the magnetic and non-magnetic portions. The following quotation will give an idea of the composition of this material as met with at Punta Arenas (on the Straits of Magellan):—Non-magnetic portion—Titanic acid, 19·2; protoxide of iron, 29·7; peroxide of iron, 49·7; lime, 0·9; magnesia, 1·0. Magnetic portion—Titanic acid, 22·8; protoxide, 15·8; peroxide of iron, 61·5.

Mineral Resources of the Ariege.—M. Mussy.—A lengthy monograph of one of the Frontier Departments of France, bound by Spain and the ancient Republic of Andorra.

Journal für Gasbeleuchtung, March, 1870.

Bicarbonate of Ammonia in Illuminating-Gas.—Dr. Rudorff.—The author states that, during the very severe cold which prevailed at Berlin in the month of February last, a quantity of crystals were found deposited in the purifiers of one of the gas-works at Berlin. The substance exhibits a distinctly-crystalline, well-defined, rhombo-prismatic structure. On analysis, the author found, as the average of three experiments, this compound to correspond with the formula, NH_4HCO_3, containing 21·52 per cent of ammonia. The crystals are interesting, since it has hitherto found impossible to prepare this bicarbonate artificially.

Regulation for Securing the Use of Gas with Safety and Advice as regards the Arrangements of the Gas-Fittings in Dwelling-Houses, Offices, and Public Buildings for Carlsruhe (the Capital City of Baden).—This paper contains some very useful suggestions for the safe employment of gas in general.

Comptes Rendus des Séances de l'Académie des Sciences, April 18, 1870.

The papers and memoirs relating to chemistry or collateral sciences in this number are:—

Clinorhombic Form of the Red Oxide of Mercury.—M. des Cloizeaux.—The author describes, at great length, the crystallographical shape of this oxide as obtained by a peculiar, but not detailed process, and incidentally mentions, that the *melaconise*, from Cornwall (a native oxide of copper), is, according to Mr. Maskelyne, the only other metallic oxide belonging to the clinorhombic system.

Second Notice relating to the Specific Heat of Water when near its Maximum Specific Gravity.—G. A. Hirn.

Experimental Researches on Gold and its Compounds.—J. P. Prat.—The main features of this lengthy paper are the following:—In order to obtain the best possible solution of gold, the two constituents of the aqua regia, nitro hydrochloric acid, should be each diluted with their own bulk of water previous to being mixed together; the metal having been dissolved, of course heat is to be applied. The previously quite cooled liquid is neutralised with bicarbonate of potassa; and, next, oxalic acid is added, which causes the reduction of the gold to the metallic state, but in the shape of a very finely-divided powder, which, however, agglutinates by applying heat, so as to become a spongy mass, which may readily be kneaded into shape by the fingers. The author describes the combinations of gold with oxygen and with chlorine—to wit, an intermediate, or olive-coloured oxide, Au_2O_2; a binoxide, AuO_2; a protochloride, sesquichloride, and perchloride (the latter a volatile substance). Among the salient points resulting from the author's researches, the most remarkable is that gold may be directly oxidised and salified by some of the oxacids, and that, in many instances, gold behaves with reagents as other metals do.

Spectrum Analysis of a Sun's Spot.—G. Rayet.

Variations of the Index of Refraction of Water, as Dependent upon its Temperature.—M. Croullebois.

Assay of Silver which contains Mercury.—H. Debray.—This paper, especially interesting to those who have daily to make assays of silver by the moist way, or Gay Lussac's process, is not well suited for abstraction; and it, moreover, appears that the author is unaware of the fact that, some fifteen years ago, Prof. G. J. Mulder pointed out what is here brought forward as something quite new, in his work (published in the Dutch language) "On the Assay of Silver by the Moist Way." The mercury here alluded to is, of course, a comparatively very small quantity, found in metallic silver occasionally.

Iodhydrates and Chlorhydrates of Monobromated Ethylen and Propylen.—E. Reboul.

New Researches on Black Phosphorus.—M. Blondlot.—The author states that, after having given away all he had of black phosphorus prepared by him in 1866 by Thenard's method, he set to work, some short time ago, to prepare a fresh quantity, but did not succeed until he added some mercury and heated the metal along with it. His researches on the nature of the *pigmentum*, as he calls the black phosphorus, prove that it does not contain even the least trace of mercury; and he concludes that it merely acts catalytically in this instance.

Dextrine Insoluble in Water.—M. Musculus.—It appears, from this lengthy paper, that dextrine may be obtained in a state insoluble in water by acting upon starch with either very strong acetic (glacial) acid; or, also, by modifying the action of sulphuric acid and water upon starch. The dextrine separates in the shape of rather bulky granules, which increase in size (they are, however, very small, because their diameter varies from 0·001 to 0·030 m.m.) according to the length of time they are left in the mother liquor wherein they are formed; these granules are insoluble in cold water, but are suddenly dissolved when they are placed in water at 50°, and they then remain soluble.

Chloronitric and Bromonitric Ethers of Glycerine.—L. Henry.—The author first observes that the only nitric acid compound, as yet known, of glycerine, is the trinitrine of glycerine, a substance of too great notoriety under the misnomer of nitroglycerine. The author next describes, at very great length, the preparation and properties of—

Monochloro-dinitrine, $(C_3H_5)(NO_3)_2Cl$; monochloro-mononitroglycerine—

$$(C_3H_5)ClO + H(NO_3) = (C_3H_5)Cl(HO)(NO_3);$$

monochloro-dinitroglycerine—

$$(C_3H_5)Cl(HO_2)(NO) + H(NO_3) = (C_3H_5)Cl(NO_3) + H_2O;$$

dichloro-mononitrine, $(C_3H_5)Cl_2(NO_3)$, a colourless liquid, almost insoluble in water, but soluble in alcohol and ether (sp. gr. at 10°, 1·465; monochloro-dinitrine, $(C_3H_5)Cl(NO_3)_2$, also a liquid of great density (viz., 1·5112 at 9°).

Direct Combination of Allylic Compounds with Chloride of Iodine and Hypochlorous Acid.—L. Henry.

Formation of Urea by the Action of Permanganate of Potassa on Albumenoid Substances.—A. Béchamp.—The contents of this valuable paper may be summarised thus:—The elimination of urea in the animal body is the result of the oxidation of the albuminous compounds of the blood; and the author proves this by operating with permanganate upon pure albuminous substances, freed purposely from fatty matters and sugar, and kept in solution by means of a weak alkali.

Aurora Borealis seen on the 5th of April last.—L. Sonrel.—From this lengthy paper, we learn that this phenomenon, already alluded to by us last week, was visible over nearly all Europe, and that, wherever it was visible, the magnetic instruments were violently agitated. The author enters into a great many details on this subject, among which the most remarkable is that the Aurora was accompanied, or preceded, for a brief period, by a very disagreeable smell (the quality thereof is not specified), very perceptible, as well at Dinkelsbühl (Bavaria), as at Paris. In high northern latitudes, this phenomenon is often accompanied by a peculiar, somewhat sulphurous, and rather oppressive, smell.

Poisonous Property of some of the Products of the Phenic Acid Series.—P. Guyot.—The accidents caused by such products as coraline, azuline, &c., depend simply upon the mode of preparation employed; for, if excess of aniline or phenol is present, the material becomes poisonous.

Earthquakes and Volcanic Explosions observed in the Netherlands' Indies from the beginning of the 16th century to the present time.—L. de Backer.—This paper, or, rather, chronological enumeration of volcanic eruptions, earthquakes, and other volcanic phenomena, vomiting of mud and boiling water from a series of volcanoes in the Indian Archipelago, begins with the year 1506, and comes down to our days. No portion of the inhabited globe, during its present geological age, has been the scene of such great and continuous volcanic action as that beautiful portion of the globe here alluded to. This paper is a very valuable contribution to our knowledge of the effects of volcanic action in various ways. The number of earthquakes and eruptions noticed (viz., by Europeans, and recorded by them) from 1506 to 1847 alone amounts to 141; and there is, as observed by Dr. Junghun, very great reason to suppose that this number is 50 per cent too low.

The American Journal of Science and Arts, March, 1870.

This number contains the following original papers relating to chemistry and collateral sciences:—

Photometric Experiments.—Part I.: On a Simple Form of Photometer for Determining the Amount of Light Reflected by Metallic Surfaces at Different Incidences.—Ogden N. Rood.—Illustrated with woodcuts, without which an abstract would not be understood.

Contributions to the Chemistry of Copper.—T. Sterry Hunt.—Reserved for full reproduction.

Silver Mines of Santa Eulalia, State of Chihuahua, Mexico.—James P. Kimball.—A very interesting contribution to the history of silver mining; also bearing testimony to the enormous mineral wealth of Mexico.

Machinery and Processes of the Industrial Arts, and Apparatus of the Exact Sciences.—F. A. P. Barnard.—This is the report made by the author, as U. S. Commissioner to the last Paris Industrial Exhibition, on this subject.

Norite or Labradorite Rock.—T. Sterry Hunt.

Cause of the Colour of the Water of Lake Leman, Geneva, Switzerland.—A. A. Hayes.—The author's concluding words on this often discussed and investigated subject are—"The negative results of chemical analysis, and the sufficiency of the reflected and refracted light of the sky which is over the water of Lake Leman, led me to the conclusion that the cause of the colour is found in the peculiar hue of the sky, so transmitted to the eye by a colourless water."

On the Potassio-Cobaltic Nitrite known as Fisher's Salt, and some Analogous and Related Compounds.—S. P. Sadtler.—This very lengthy treatise is filled with a large number of formulæ. The author's chief conclusion is that the salt alluded to is essentially a compound having the formula $Co_2 6NO_2 + 6(KNO) + aq$.

Meteors of November, 1869.—H. A. Newton.

Zeitschrift für Chemie von Beilstein, No. 6, 1870.

This number contains the following original papers:—

On Tetramethyl-Benzol.—P. Jannasch and R. Fittig.—After having entered, at some length, into speculative discussions referring to the possibility of the substitution of more than three atoms of hydrogen in benzol, the authors describe, at great length, the process of preparation whereby they obtained a tetramethyl-benzol, $C_{10}H_{14} = C_6H_2(CH_3)_4$, which substance they have called *durol*, because there may exist several modifications of tetramethyl-benzol. Durol is the only hydrocarbon yet known belonging to the benzol series, which is a solid body at the ordinary temperature of the air. It is crystalline; readily soluble in alcohol, ether, and benzol; fuses about 80°, and boils at between 189° and 191°; is specifically lighter than water; and, when burning, exhibits a very luminous flame. Dinitrodurol, $C_{10}H_{12}(NO_2)_2 = C_6(NO_2)_2(CH_3)_4$, is obtained by the action of very strong nitric acid upon durol. Dinitrodurol is also a solid, crystalline body, readily soluble in ether, less readily in benzol and in boiling alcohol, fuses at 205°, and is sublimed without decomposition. Dibromo-durol, $C_{10}H_{12}Br_2 = C_6Br_2(CH_3)_4$, a solid substance, very difficultly soluble in alcohol, fusing at 199°, and sublimable without decomposition.

Aceton-Sulpho Acid.—Dr. Bender.—The author prepared this substance from dichloracetone and a solution of neutral sulphite of potassa, yielding aceton-sulpho-potassa—

$$C_3H_5SO_4K = CH_3 - CO - CH_2 - SO_3K.$$

By treating this salt with dilute sulphuric acid, no sulphurous, nor sulphuric acid, is given off; but the aceton-sulphic acid was not obtained in free state.

Some of the Derivatives of the Toluol Series.—E. Wroblevsky.—This paper might almost be compared to a catalogue. The author enumerates, first, isomeric monochlor-methyl-phenetols, viz.—*a* methylchlor-phenetol, a fluid boiling at about 220° (sp. gr. at 19°, 1·127); *β* methylchlor-phenetol, also a fluid boiling at 220° (sp. gr., 18°). Secondly, isomeric chlor-iod-toluols, viz.—*a* C_7H_6ClI, a fluid boiling at about 242° (sp. gr. at 17°, 1·716), and is not solidified at −14°; *β* C_7H_6ClI, again a fluid boiling at 240° (sp. gr. at 19°, 1·770). Thirdly—Paraiod-orthobrom-toluol, C_7H_6BrI; dichlortoluidine, $C_6H_3Cl_2.CH_3$; nitro-dichlortoluol, a fluid exhibiting the smell of nitrobenzol, soluble in alcohol and ether, and boiling at 274° (sp. gr. at 17°, 1·455).

Isomeric Nitro-Bromotoluols and Bromotoluidine.—E. Wroblevsky.—This paper is chiefly a critical review of the labours of a great many chemists who have been engaged in researches on this subject, and, like the foregoing paper, is a catalogue of substances.

On Diethglyoxylic Ether.—A. Schreiber.—Of the substance here alluded to, the preparation and derivation are described at great length. Diethglyoxylic ether, $CH(C_2H_5O)_2COOC_2H_5$, is a very clear, colourless, strongly-refrangible liquid (sp. gr. at 18°, 0·994), miscible with alcohol and ether in every proportion; diethglyoxylic acid amide, $CH(C_2H_5O)_2CONH_2$, is a solid substance crystalline, fusing at 76·5, and readily soluble in water and alcohol.

Conditions of the Formation of the Mono-Sulpho Acids of Naphthaline.—V. Merz and W. Weith.—This paper is not well suited for useful abstraction.

Revue Hebdomadaire de Chimie, April 7, 1870.

Preservation of Beet-Root Leaves for Fodder for Cattle.—M. Mehay.—Under this title, the author describes, at great length, a method of preservation of the leaves alluded to, but also applicable to other leaves of a similar nature, and perhaps to grass, which method consists mainly in the following process:—Into a vessel of some 2 hectolitres' capacity (about 45 gallons) are poured from 2 to 3 decilitres (each deciliter is equal to 0·176 pint, or 6·102 cubic inches) of hydrochloric acid, sp. gr. 1·18 (that is to say, an acid of 38 per cent of CHl at 15·5°); and next there is added to this acid a large quantity (how much is not stated) of water. The fluid is thoroughly mixed, by means of a wooden spatula; and next, 50 kilos. of the leaves, yet attached to the crown part of the root, which is cut off, are placed in this liquid and thoroughly immersed therein. This having been done, the entire mass is heated to the boiling-point, and kept boiling for 10 or 15 minutes; the leaves are taken from the cauldron, by means of wooden forks, and placed on hurdles, so as to admit of the surplus liquid draining off, after which the leaves are fit to be preserved in a manner similar to that in which potatoes, turnips, and the like are kept, by being placed in pits covered inside with straw, and next covered over with the soil of the garden or farm ground. We cannot enter more fully into this subject, which is, however, deserving the attention of agriculturists. The author states that the acid combines with the alkaline salts of the leaves and thus forms chlorides of sodium and potassium; the quantity of acid is too small, moreover, to affect the health of the cattle. It is clear that either iron enamelled cauldrons, or those made of copper, can only be used with open fire; where steam is at hand, well made wooden tanks may serve.

A New Manure.—M. Auvillain.—The author treats residues and offal of fish, first boiling the same, with addition of 1-10th of the weight of the mass of any cheap oil, heating up to from 120° to 140°. By this means, all the water is expelled from the offal, which is next treated with sulphide of carbon, whereby the oil naturally contained in the fish, as well as that which was added, is extracted, leaving a mass quite dry, and containing from 5 to 6 per cent of nitrogen and from 12 to 15 per cent of phosphate of lime.

Production of Petroleum (Paraffin Oils) in the United States.—L. Peaud.—It appears that the quantity produced of the substance alluded to is largely on the increase, since the average daily production amounted, in 1868, to 10,863 barrels, and in 1869, to 13,197 barrels. The stock on the first day of this year was, in the States and Canada jointly, 1,238,000 barrels.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 3, 1870.

This number contains the following original papers:—

Preparation of Ethylamines on the Large Scale.—Dr. A. W. Hofmann.—This lengthy paper treats on the preparation of ethylamines, by applying thereto the by-products obtained during the manufacture of hydrate of chloral. This material is treated in closed vessels, at 100°, with a concentrated alcoholic solution of ammonia.

Synthesis of Aromatic Acids.—V. Meyer.—This paper is subdivided into the following groups:—Synthesis of benzoic acid; synthesis of isophthalic acid; constitution of substituted benzoic acid.

Contribution to our Knowledge of the Constitution of Camphor.—V. Meyer.—This very lengthy paper, full of complicated formulæ, is not well suited for abstraction. In a foot-note, the author observes that most of the recently published works on organic chemistry quote the melting-point of camphoric acid at 62·5, whereas some six years ago, the researches of MM. Tollens and Fittig proved the melting-point of that acid to be at about 176°; and the author's researches have confirmed this particular.

Crystallized Hydrate of Soda.—O. Hermes.—The author states that, during the cold weather which prevailed at Berlin some two months ago, he had the opportunity of obtaining, from an aqueous solution of caustic soda (sp. gr., 1·365), beautiful crystals of rhombo-prismatic shape, perfectly transparent, fusing at 6°, and containing 30·09 *NaO*. The formula of this compound is, therefore, $NaO+8HO$; or, according to more recent views, $2NaOH+7H_2O$.

Contribution to our Knowledge of the Iodides.—E. Meusel.—The author describes iodide of copper, which he obtained by the slow action of metallic copper from hydriodic acid, in the shape of faintly greenish yellow-coloured tetrahedrical crystals, which become dark-coloured by exposure to light. The author next describes some experiments relating to the action of light on the chlorides, fluorides, iodides, and bromides; and, lastly, gives a review of the various analytical methods in use for the quantitative analysis of insoluble iodides. The author's method is based upon the solubility of the iodides of mercury, lead, silver, and copper in hyposulphite of soda; the metals are precipitated from that solution by hydrosulphuret of ammonium, and all the iodine remains in solution. After removal of the sulphurets of the metals, ammonia is added to the filtrate, and the liquid evaporated, so as to expel the bulk of the sulphur in the shape of sulphide of ammonium. Solution of caustic soda is next added; and, after evaporation to dryness, the saline mass is ignited, next dissolved in a small quantity of water, solution of chloride of iron is added in excess, and the iodine, after having been taken up by iodide of potassium, is estimated by titration.

On those Haloid Compounds which Correspond to Picric Acid and Dinitro-Phenol, and on some Derivatives thereof.—C. Clemm.—Under the above title, this very lengthy paper treats on chloro-nitro-benzol, chloro-dinitro-benzol, bromo-dinitro-benzol, and on nitro-derivatives of the haloid compounds here named.

On so-called Chloraceten.—A. Kekulé and Th. Zincke.—After referring, at some length, to the researches of various scientific chemists who have been occupied with this subject, the authors, in their lengthy monograph, give a series of experiments, and come to the conclusion that chloraceten is simply a mixture of aldehyde and paraldehyde, containing hydrochloric acid or chlorocarbonic gas.

Condensation of Aldehydes.—A. Kekulé.—Not suited for any useful abstraction.

Products of the Oxidation of Paraffin.—E. Willigk. This paper, a preliminary notice, contains the description of a series of experiments, whereby pure paraffin, treated at a high temperature with a mixture of nitric and sulphuric acids, is made to yield materials which belong to the series of fatty acids. The author's researches on this subject are not, however, quite complete.

No. 4.

Contains—

Products of Distillation of Coal-Tar which Boil at a High Temperature.—C. Graebe and C. Liebermann.—The authors state that they obtained, from a tar distillery at which the distillation is pushed till a coke only remains, a

solid, lemon-yellow coloured, fatty-looking material, fusing at 150°, while its boiling-point is higher than that of mercury. This material was soon recognised by the authors to be a mixture of various substances, but chiefly made up of chrysen, which, after having been purified, was found to fuse at from 245°—248°, and difficultly soluble in alcohol, ether, and sulphide of carbon, a little more readily soluble in boiling anhydrous acetic acid and in benzol. The authors have studied, also, some of the products of oxidation of chrysen, and among these a body called chrysochmon, $C_{18}H_{10}O_2$. The formula of chrysen is $C_{18}H_{12}$.

Betaine and its Constitution.—C. Schiebler.—This lengthy paper is illustrated by diagrams, and, therefore, like the following—

Identity of Oxyneurine and Betaine—Dr. O. Liebreich—Not suited for aostraction.

Chlorophosphide of Nitrogen.—H. Wichelhaus.—This paper contains a review of the labours of various authors on this subject.

Description of an Improved Shape and Arrangement of Hofmann's Apparatus for the Determination of Vapour Densities.—H. Wichelhaus.—This paper is illustrated by a woodcut, essentially required to the proper understanding of the contents.

Our Present Knowledge of the Mineralogico-Chemical Properties of Meteorites.—C. Rammelsberg.—A lengthy essay, chiefly of mineralogical interest.

Contribution to the History of the Platinum Bases.—Charles Gordon.—A review of the labours of Reiset, Magnus, Raewsky, and others on this subject.

On Paytine.—O Hesse.—Under this name, derived from the seaport of Payta (Peru), the author describes a new alkaloid, found by him in the cinchona bark shipped from the place alluded to. Paytine, $C_{21}H_{24}N_2O+H_2O$, is readily soluble in ether, benzol, chloroform, and alcohol, but very difficultly soluble in water; fuses at 150°; exhibits an alkaline reaction to test-paper, but does not very readily form salts, nor is it quite neutralised with acids. On being heated with soda-lime, paytine yields a substance, paiton, free from nitrogen.

New Organic Phosphorus Compound.—L. Darmstädter and A. Henniger.—The author describes a material accidentally discovered by him, and found to be cyan-ethyl-phosphide, C_2H_5NP. In 100 parts—C, 41·37; H, 6·90; N, 16·09. Since the quantity obtained was very small, no other experiments could be made with this substance.

NOTES AND QUERIES.

Glycerine.—It will be a favor if you can inform me of a good test, or tests, to ascertain the commercial value of glycerine, and that it has not been adulterated with glucose or other matter.—Subscriber.

Volatilising Common Salt.—Would any of your readers kindly inform me of the best means of volatilising common salt? Must superheated steam be driven through it, or will an extreme heat be all that is necessary?—Enquirer.

Dinitrobenzol.—I shall be glad if any of your correspondents can tell me of a better process for making this substance than those given in "Watts" and "Miller." I have tried them and have not succeeded in making it.—W. H. W.

Liq. Ammoniæ.—(Reply to J. Spencer.)—You can find the description of the apparatus you want in the work on Technology, published by M. Baillière, and edited by Dr. Richardson and Mr. Watts. The work may be inspected at the Library of the Commissioners of Patents. Our space is too limited to describe the apparatus here.

Dr. Schiebler's Apparatus.—(Reply to W. R.)—When the earlier portion of my notes were prepared the fifth edition of "Fresenius" was not published—the publication being almost simultaneous with the appearance of my first paper. For general description of apparatus consult "Fresenius" (4th edition, p. 711). The apparatus I work with was purchased in Berlin, but is, I think, supplied by Dr. Schiebler, Stettin, for 20 Thalers (about £3), complete. It is applicable for all carbonates where carbonic dioxide is the only gas evolved.—W. Ashot.

Alumina.—(Reply to Arthur Warner.)—Wavellite is not, as you suppose, a native alumina, but the native phosphate of that base. Whether or not any pure native hydrate of alumina occurs in Cornwall, we are not now prepared to say. Under the name of bauxite, a native hydrate of alumina of great purity occurs in the south of France. Kaolin, after thorough calcination, may be made to yield, by treating it with boiling sulphuric acid (sp. gr., 1·384), very pure sulphate of alumina (alum cake); and kaolin is abundantly found in Cornwall. On perusal of our advertising columns, you will find that pure alumina is advertised for sale.

Removing Silica.—(Reply to W. H.)—The silica is present in the carbonate of potassa chiefly as a silicate; and it is stated in the *Handwörterbuch der reinen und angewandten Chemie* that digestion of this salt with pulverised charcoal will decompose the silicate. Your best plan, however, is, since it appears that you have to deal with a very crude material, to dissolve it in three-fourths of its weight of cold water, and, after decantation of the solution, leave the residue exposed to air, the carbonic acid of which slowly decomposes the silicate. The aqueous solution obtained should be evaporated to dryness, when it will yield a pretty pure carbonate of potassa.

To Purify Methylated Spirit.—(Reply to "Bichromate.")—Arrange an apparatus as for the continuous distillation of ether, but let the proportion of sulphuric acid be less than is necessary for etherification. Probably there is but little destruction of methyl, but the effect is very materially to sweeten the filthy compound. The distillate is acid, and must be drawn over again, after digestion with carb. of potassa.—R. T. Clarke.

Dissolving Cellulose.—(Reply to "Bichromate.")—It appears, from the researches of M. Persoz, jun., that the easiest plan for preparing a very active ammonio-cupric solution is to cause strong liquid ammonia to act upon a piece of copper with contact of air, briefly to stir strong liquid ammonia with a piece of copper, until the fluid, of which, now and then, a small sample may be taken for testing, dissolves cotton readily in the cold; wool is insoluble in this fluid in the cold, but is readily dissolved when heat is applied. Chloride of zinc solution of a sp. gr. of 1·718 dissolves silk slowly in the cold, rapidly by application of heat (see, on this subject, J. Persoz's paper in the *Comptes Rendus*, vol. iv., p. 810 (1862), which you can peruse at the Patent Office Library). As to a cheap method of destroying the smell of methylated spirits, you might try re-distillation, after having left the fluid in contact for some time with some quick-lime and well-burned charcoal.

Hardness of Water, &c.—I shall be favored by an explanation of this anomaly in testing the hardness of water by Clark's standard. Supposing a water requires 32 soap tests to produce a permanent lather for 10 minutes; such water would be called of 10° hardness. Take another water, requiring, say, 34 soap-tests, the hardness of which would be, by the scale, 15 and 4-10ths degrees. Thus—2-34ths degrees = 17 and 17 soap-tests = 7 and 7-10ths degrees, which, multiplied by 2, = 15 and 4-10ths degrees, being actually less than a water requiring but 32 soap-tests, whereas we know that such water would really be harder than the first example! And, query, is the native sulphate, selenite, or the artificial chloride of calcium, preferable as a standard solution?—W. E.

Baumé's Hydrometer.—(Reply to J. T. E.)—You cannot certainly use this hydrometer (better, areometer) for determining the specific gravity of glass. If you want to know that, you could use Nicholson's hydrometer, with weights, which is an instrument made of brass, and sold by instrument makers; or you may determine the sp. gr. of the glass by the well-known methods described in books on natural philosophy. The specific gravity of the glass the hydrometers are made of, whether graduated according to Twaddle's, Baumé's, Beck's, or any other scale, has nothing to do with the instrument as constructed for use; but very frequently the instruments sold are not very well constructed, and mutually differ as to their indications, even at the same temperature. The average sp. gr. of glass varies, according to its composition, from 2·04 to 3·77.—Nemo.

Caustic Soda and Lime.—Perhaps some of your readers will explain the following, as I do not find anything relating to it in any work I have at hand:—Having occasion to use caustic soda in considerable quantities, and finding that unless sufficient lime has been used to decompose the whole of the carbonate of soda, it does not answer my purpose, and wishing to have some means of ascertaining this readily, I thought lime-water might answer on the supposition that if the soda solution contained carbonate of soda the lime would be precipitated as carbonate of lime. I tried several samples with it, each of which produced a white precipitate. I then tried the purest caustic soda I could get at an Manchester, with the same result. I afterwards diluted a sample of commercial caustic soda to sp. gr. 1075, and added lime-water so long as any precipitate was formed, then filtered it, and concentrated the clear liquor quickly to about 1030 sp. gr.; on again adding lime-water to this, the lime was precipitated as before. What I wish to know is whether I am right in inferring that in each case the precipitate was caused by the presence of carbonic acid, and taking that for granted, how is it (as in the instance given) that the solution which would not give any further precipitate should, on concentration, again have that property. Would it be owing to carbonic acid absorbed from the atmosphere?—Enquirer.

Glycerine.—"Subscriber" is referred to pages 72 and 167 of our 19th volume (*Am. Repr., April, '69, page 213, and June, '69, page 334*).

Volatilising Common Salt.—(Reply to "Enquirer.")—Common Salt is readily volatilised in the presence of aqueous vapours, and is by no means a non-volatile substance, even at temperatures short of red heat.

Burwood Red and Indigo Blue.—Perhaps some of your numerous correspondents would favour me with the best modes of producing the above on cotton cloth, both as regards brilliancy of colour and economical production.—Chemicus.

Dr. Schiebler's Apparatus.—If W. R. will refer to the new edition of Fresenius's "Quantitative Analysis," under "Carbonic Acid Estima-

[English Edition, Vol. XXI., No. 544, page 203; No. 540, page 156; No. 541, page 168.]

tion," he will find a description and figure occupying three pages.—A. V.

Detection of Linseed Oil in Rape Oil.—(Reply to B. Ludlow.)—See CHEMICAL NEWS, vol xix., pp. 238 and 252 (*Am. Repr., July*, '69, *pp.* 32 *and* 51). There does not exist, as far as we have been able to ascertain, a special work on oils, either in the English or any other language.

Native Crystalline Phosphates.—Apatite occurs, in the crystalline state in various forms, and so do other phosphates; and therefore the statement made by Mr. Hutton, in reference to the Canadian phosphate, should be taken in less a decided and exclusive manner. Any work on mineralogy will prove the existence of a variety of native crystalline phosphates.—T. A.

Dinitrobenzol.—(Reply to W. H. W.)—There is no doubt that the methods for preparing this compound as described by Dr. Miller and Dr. Watts, are as good as any; if you desire others, you should peruse such periodicals as the *Bulletin de la Société Chimique de Paris*, the *Annalen der Chemie und Pharmacie*, and the *Zeitschrift fur Chemie von Beilstein*, all of which you may inspect at the Library of the Commissioners of Patents.

Hardness of Water.—(Reply to W. R.)—A water of 15 and 4-10ths degrees would require 31 measures of soap, but if diluted to twice its volume, it would require 34 measures of soap. Take another instance: the standard water, if diluted to twice its volume, would require 35 measures of soap. The extra quantity of soap used, after diluting, represents the hardness of the pure water added. Selenite is preferable to calcium chloride for the standard water, as it requires no preparation; when finely powdered, it readily dissolves. A useful table will be found in the new edition of Fresenius's "Quantitative Analysis," which is an expansion of Clark's, and saves all trouble of calculation; it gives the soap-test required from 0° to 16°, at intervals of 1-10th degree.

Brazwood-Red and Indigo-Blue.—(Reply to "Chemicus.")—You may consult "Die Färberei der Gespinnste und Gewerbe von Reimann" (p. 28 and following, and 210 and following), where you will find a great many practical receipts.

Chlorate of Soda.—I cannot succeed in making chlorate of soda satisfactorily by means of tartrate of soda and chlorate of potash. Large proportions of the two salts remain undecomposed, and I found a sample of commercial soda chlorate nearly as bad as my own. —W. H.

Sulphate of Ammonia.—Would you kindly tell me what proportions of sulphate of ammonia, lime, and water (say to 1 cwt. of sulphate) are used in practice for making liquor ammonia. I have no work that gives any particulars worth naming—Watts's "Chemistry" is rather too expensive.—A WORKING MAN.

Colouration of Glass.—I was to-day shown a piece of glass which lately formed a part of the Laud's End light-house, the lamp of which was broken by a heavy sea some time back. This glass exhibited a rather striking peculiarity, the explanation of which I seek from the courtesy of your readers. The piece in question was about 3 inches long by 2 inches broad, and ⅜ an inch thick, and was of a beautiful amethystine colour where, probably, acted upon by the light; but at the edge, where protected by putty or other sheltering material, the glass had entirely retained its white transparent hue. Not only was the surface affected in this manner, but the colouration apparently extended completely through the glass.—ELIA.

[Such colouration, under the influence of light, is not uncommon when the glass contains manganese.—ED. C. N.]

Detection of Strychnia in Organic Matter.—Can any of your readers inform me where I can find a description of Stas's process for the detection of strychnia in organic matter.—ALPHA.

Chlorate of Soda.—"W. H." is referred to Brande's "Manual of Chemistry, vol. i., pp. 563, 609. This work may be inspected at the Library of the Commissioners of Patents.

Wood-paper.—I observe in an advertisement in the CHEMICAL NEWS that Dr. Moffat mentions wood-paper in a list of his investigations. Being anxious for information on the subject of wood-paper, I should feel greatly obliged if the learned Doctor would kindly let me know where his investigations are published. Has any other celebrated chemist devoted attention to the subject?—A. B. V.

Sulphate of Ammonia.—(Reply to "A Working Man.")—When chloride of ammonium is used for the purpose you allude to, 5 parts of that salt, previously powdered, are mixed with 4 parts of slack lime, and the mixture is moistened so as to form lumps when squeezed in the hands. With sulphate of ammonia you should take equal parts by weight of both lime and the sulphate (a slight excess of the former is preferable), and water as just stated. Sulphate of ammonia only yields 23 per cent of ammonia gas, whereas sal ammoniac yields 32 per cent.

Latent and Sensible Heat.—It is a well-known fact that copper and spelter when brought together, as they are in making brass and yellow metal, generate a large amount of heat in excess of that which they had separately or collectively possessed before. Now I would feel it a great kindness if you would inform me what this excess of heat amounts to, and how it is accounted for. Suppose, for example, 60 lbs. of copper at its point of liquefaction, or 1996° F., and 40 lbs. of spelter at say 720°, or its point of liquefaction, were put together, what would be the degree of heat or the temperature of the compound?—COMPOUND.

Continuous Current of Air.—In your last number I am reported to have told the Chemical Section of the Glasgow Philosophical Society in my paper on "A Method for Obtaining a Continuous Current of Air, &c.," that, from calculations made, I had no doubt that, with a Herapath lamp, I could get a blast quite as strong as that obtained by using the Griffin lamp. As nearly as I can remember, what I *did say* was that "I was not possessed of a Griffin lamp. But I did not think the blast of air obtained by this apparatus would be sufficiently strong to consume the gas delivered by one; because with a Herapath lamp, the blast of air obtained was just sufficient to maintain a blue flame when the gas stopcock was full open, and the pressure in the main not greater than 27 mm., or so." By giving this correction a place in your next issue you will greatly oblige.—T. L. PATTERSON, Greenock, April 18th, 1870.

Detection of Strychnia.—(Reply to "Alpha.")—Stas's method will be found in Fresenius's "Quantitative Analysis," p. 243.—A. V.

Drop Black.—I would like to know the method of preparing the substance sold under the names of drop black and imperial drop black. I cannot find any information in books regarding it.—P. H.

Ozone.—Upon examining the contents of some bottles in which N had been prepared by the slow oxidation of iron filings, I found abundant evidence of ozone, both by smell and by the ordinary starch test. —T. B.

Latent and Sensible Heat.—(Reply to "Compound.")—It would be very difficult, if not altogether impossible, to estimate the amount of heat you allude to; but the cause of it is that a chemical combination takes place, attended by the phenomena you allude to; and that this explanation holds good has been proved by Dr. J. H. Crookewit, who, now some twenty years ago, made a series of experiments, on a sufficiently large scale, on the metallic alloys. His researches have been published as a separate Dutch work; but, as far as our recollection goes, the author was not able to estimate the amount of heat set free during the sudden combination of the metals you allude to. The cause of this failure is the obvious fact of the want of proper means of estimating high temperatures with sufficient accuracy.

Pyro-Electric Gilding.—In your issue of the 14th inst. (*Am. Repr., June*, '70, page 357), I see a quotation from the *Bulletin de la Société d'Encouragement pour l'Industrie Nationale* (No. 206, February, 1870), to this effect:—"*Pyro-Electric Gilding Invented by M. Masselotte, to whom a prize of £20 has been given.*—M. Barral.—From the author's report, it appears that this invention is very valuable, since it possesses all the advantages of the best method of mercurial gilding, without being at all detrimental to the workmen." I have been practising this system of gilding and silvering now for over five years under this very title, and was the first to invent the process and used the title. In 1865, I patented this method in France; and in 1868 I patented an improvement on this method in France. M. Masselotte may not have seen my specification, but using the exact title looks suspicious.—J. BAYNES THOMPSON, Electro-Metallurgist, Pyro-Plater, &c.

[By referring to the original report, of which we gave an abstract, Mr. Thompson could at once see if the two processes are similar.—ED. C. N.]

Sulphur in Coal-Gas.—The following note of the formation and condensation of sulphuric acid by the combustion of sulphur compounds in coal-gas in a common fish-tail burner shaded by an ordinary ground-glass globe may, perhaps, interest some of your readers:—Having occasion to take down a gas globe, I noticed a number of brown drops of liquid scattered over its internal surface; on collecting and testing them, they were found to consist of pretty concentrated sulphuric acid, the comparatively high degree of concentration being due to the great temperature acquired by the globe, the heat being far greater than the hand could bear. The brown colour was, doubtless, produced by the carbonisation of organic dust. Also two or three strips of copper, placed over the mouth of the globe to support a shade, were found to be coated with subydrous cupric sulphate. From the short time which had been taken in the production of the acid (a fortnight, the gas burning for about three hours of an evening, at the rate of 5 ft. an hour), I should think the gas was rather too rich in sulphur to be an unmitigated good to the consumer.—ARCHID. LIVERSIDGE.

ANSWERS TO CORRESPONDENTS.

NOTICE—The American Publishers of THE CHEMICAL NEWS *give notice that, in accordance with a suggestion of* MR. CROOKES, *the Editor and Proprietor of the English Publication, they will be pleased to receive and forward to him in London any scientific publications issued in America, for review—and also any Notes and Queries, Articles, Correspondence, etc., for publication or reply. Their facilities of communication with* MR. CROOKES *render this very desirable to all persons in the United States who wish to confer with him. Address to him, care of*

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434 Broome Street, New York.

W. R.—Your first letter was in type when your second letter arrived.

Alcohol.—Full directions for the preparation of hydrate of chloral have already appeared in our columns.

J. M.—You had better advertise.

W. Arnot.—Received. Many thanks for the trouble you have taken in the matter.

R. W.—Our advertisement-sheet is the proper medium for making your wants known. We can only insert replies to queries which are likely to be useful to our general readers.

A Reader, Redditch.—Consult "Cooley's Cyclopædia of Practical Receipts," published by Churchill.

Chemicus.—It will not be published before the autumn.

P. Holland (Manchester).—Any work on Chemical Analysis will give you the information you require.

Bichrome.—The lead pump has not made the water hard; it has probably become so from natural causes.

James Bebbington.—Metallic cobalt is not found native, neither is it met with in commerce except as a scientific curiosity.

AMERICAN SUPPLEMENT.

New York, June, 1870.

Historical Notes on the Defunct Elements.

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EARTH, air, fire, and water, the four elements of Aristotle's age, and mercury, salt, and sulphur of the visionary alchemists, can hardly be included in the term "Defunct Elements;" the history of the latter properly beginning at a later period, simultaneous with the rise of modern chemical science.

Almost as soon as the term element was employed in its present signification, and the discovery of new elements was chronicled, chemists began to accumulate material for a catalogue of defunct elements. The latter half of the eighteenth century witnessed the discovery of sixteen *bonâ fide* elements; it was during this period of great chemical activity that the defunct elements originated.

A complete catalogue of these elements is nowhere found; startling announcements of their birth, and modest notices of their death, are scattered throughout periodical literature. This has greatly increased the labor of collecting them, but it is believed that the following list is comparatively full:—

TERRA NOBILIS.

Taking them up in chronological order, the first (claiming only passing notice) is Terra nobilis, discovered in 1777 by Torbern Bergmann. Bergmann based his discovery on the fact that the silex of which diamonds were supposed to be composed, yielded peculiar reactions before the blowpipe, quite different from the silex of other minerals; accordingly he called the earth *Terra nobilis*, or *Edelerde*. His theory was short-lived, though the true composition of diamonds was not established until the year 1814, by Sir H. Davy.

HYDROSIDERUM.

In 1780, Meyer, an apotheeary of Stettin, observed that upon treating crude iron with strong acids he always obtained a residue and not understanding the reactions of the black powder, he pronounced it a new metal. At first it was called Hydrosiderum, "Wassereisen," but Bergmann, who confirmed his statements, shortened the name to Siderum. Meyer made a careful and laborious examination of this substance, the account of his researches filling more than thirty duodecimo pages, but he failed to establish its identity.

Klaproth and Scheele soon after showed that Hydrosiderum was nothing more than a compound of iron with phosphorus.

AUSTRALIUM.

Josiah Wedgewood, better known by the ware and the pyrometer called by his name than from chemical researches, analyzed, in 1790, sand from Sydney, New South Wales. From this he obtained an earth possessing the peculiarity of being soluble in strong hydrochloric acid and precipitated by water, and he called it Australia, or Sydneia. Klaproth expressed doubts as to the accuracy of Wedgewood's experiments; and Hatchett, in 1798, after careful analysis, pronounced Australia nothing but a mixture of alumina, iron oxide, silica, and graphite.

AGUSTUM.

Agustum, or rather "Agusterde," for so the oxide was called, was discovered in 1800, by J. B. Trommsdorff, Professor of Chemistry in the University of Erfurt. The peculiar earth was extracted from the mineral then known as "Sächsische-beryll." Trommsdorff named it *A-gust-erde*, from its forming tasteless salts. Some of the material he sent to his friend Richter, who was engaged in examining it when he learned that the French chemist Vauquelin had ascertained it to be phosphate of lime. In fact, "Sächsische-beryll" is now known as *Apatite*.

Richter afterwards succeeded in making a mixture of carbonate and phosphate of lime, exhibiting behavior with reagents identical to that of Agusterde; he also pointed out that Trommsdorff had relied too exclusively on stoichiometrical results, and had neglected the necessary qualitative examination.

SILENIUM, OR "SILENE,"

Was discovered in 1803, by Proust, Professor of Chemistry at Madrid. It proved, however, to be Uranium, which was of comparatively recent discovery.

NICCOLANUM

Was discovered in 1805, by Richter, in Saalfelder cobalt ores. The metal very closely resembled nickel, but was distinguished from it by its color, which was nearer that of iron, by being ductile only when cold, and not reducible by heat; while it was distinguished from cobalt by its forming green solutions, which turned red on evaporation. Richter classed it among the noble metals. Two years later we find him sceptical as to its existence, and in 1808, Hisinger and Berzelius, having obtained some of his material, settled the question by showing it to consist of nickel, containing about six per cent. of cobalt, with some iron and a little arsenic.

ANDRONIA.

J. J. Winterl was Professor of Medicine, Chemistry, and Botany at the University of Pesth. Not possessing any skill as a manipulator, he turned his attention to theoretical chemistry, and published about the beginning of this century a pamphlet entitled "*Prolusiones ad chemiam sæculi deciminovi*," in which he set forth his peculiar views; this essay, and another issued shortly after ("*Accessiones novæ ad prolusionem*," etc.), contain the most extraordinary creations of fancy, unworthy of the enlightened period in which he lived, and pronounced by contemporaneous chemists a return to the alchemistic age. Winterl finds the antiphlogistic theory, as established by Lavoisier and his compeers, altogether unsatisfactory, and he evidently intends to completely overwhelm it with his own brilliant ideas. This is not the place, however, to discuss what is known as the dualistic theory,* though it excited great controversy, as the numerous essays in the journals of that day abundantly testify.

The absurdity of Winterl's speculations was only equalled by the inaccuracy of his experiments; his reasoning with reference to Andronia will amply suffice for example.

He states that "in all nature we find a substance having these properties: *first*, acidity; *second*, non-volatility; *third*, yielding with a little oxygen, nitrogen; with more oxygen, carbonic acid; and much of both, nitric

* Winterl's System d. dualist. Chemie dargest., von J. Schuster. Berlin, 1807.

acid!" Combined with hydrogen it forms the material of which the greater part of organic matter is composed; "consequently," he argues, "it is to be found in charcoal," and he claims to prepare it by igniting charcoal with saltpetre and exhausting the residue with water. The material thus obtained and possessing the above-mentioned remarkable properties he called Andronia. It seems strange that any one, even at that early day, could be found to credit such absurdities, but we find that Oersted condescended to repeat the experiment just named *nine* times, "obtaining," he gravely says, "a little silica." Bucholz also denied Winterl's statements, and many chemists opposed his theories. Winterl replied to their objections with new proofs (?), and finally sent a specimen of his precious Andronia to the French Academy of Sciences, where a committee of such distinguished philosophers as Berthollet, Fourcroy, and Vauque'in were appointed to examine it.

It is scarcely necessary to add that they found it to consist of a mixture of lime, alumina, iron oxide, and silica, which constituents, they remark, probably came from the *earthen crucibles* in which Winterl's experiments were conducted.

Thelike, another equally remarkable element, which Winterl discovered at the same time, only requires mention for sake of completeness.

NITRICUM, ARÆON AND MURIUM.

Equally worthy of credence stand the hypothetical elements here named. *Nitricum* is the name proposed by Berzelius for the imaginary body which, united with oxygen, forms nitrogen. *Aræon*, according to Meissner, is *ponderable caloric*, elements being compounds of Aræon with unknown radicals; thus hydrochloric acid is formed of two equivalents of oxygen, one of water, combined with Aræon and the radical *Murium*.

JUNONIUM

Was discovered by Prof. Thomson, of Edinburgh, in 1811, in the mineral Allanite; its identity with Cerium was shortly proved by Wollaston.

THORIUM.

In 1815 Berzelius announced the discovery of a new earth in Fluocerite and Gadolinite, which he called Thoria, but he afterwards found it to consist of phosphate of yttria, and for a few years Thorium was accounted a defunct element. Having the good fortune to discover, in 1828, a new earth much resembling the old Thoria, he revived the name, and thereby erased his own name from the class of discoverers of whom we write.

VESTIUM.

The year 1818 was rendered memorable by the discovery of two defunct elements, Vestium and Wodanium. The same volume of, Gilbert's Annalen which announces the discovery of Cadmium by Hermann and Stromeyer, contains an account of Vestium. This metal was discovered by Von Vest, Professor at Gratz, in nickel ore from Steyermark; Von Vest first called it Sirium, but Gilbert proposed the name of Vestium, from the planet Vesta; "reminding one also," he naively adds, "of the eminent discoverer." Gilbert urges in this connection Klaproth's example in deriving the names of elements from the heavenly bodies, and as Berzelius and Wollaston have already supplied us with cerium and palladium, Gilbert suggests the propriety of completing the list by calling Stromeyer's metal "Junonium" and Von Vest's, "Vestium." The interest which Gilbert took in christening these elements was all in vain; Junonium is to-day known as Cadmium, while Vestium is utterly forgotten.

Faraday, at that time assistant to Davy, found conclusively that Vestium was a mixture of nickel, iron, sulphur, and arsenic.

WODANIUM

Was discovered in nickel ore by Lampadius, Professor at the Freiberg School of Mines; the name is derived from *Woden*, the same Scandinavian deity who has bequeathed us his name in the more familiar term Wednesday. Lampadius describes the metal as of a light bronze color, malleable, and magnetic, forming colorless solutions which yield a white precipitate with carbonates and a light blue with ammonia; and to render its precise nature as definite as possible, concludes by saying that "Wodanium bears the same relation to nickel that tellurium does to antimony." In 1820 Stromeyer analyzed the mineral called Wodankies, and found it to consist of about 16% nickel, 4% cobalt, 11% iron, 56% arsenic, and 10% sulphur, but no trace of Wodanium. The mineral is now known as Gersdorffite.

CRODONIUM.

J. B. Trommsdorff, not discouraged by his ill success with Agusterde, announced in 1820 the discovery of another element, which he extracted from the incrustation on a carboy of sulphuric acid imported from England. The name Crodonium is from *Crodo*, an idol held in veneration by the ancient people of Thuringia, the capital of which (Erfurt) was Trommsdorff's adopted town. Having worked up all his material, he experienced much difficulty in finding any acid having a similar deposit, but at length secured sufficient to ascertain that it consisted of lime and magnesia rendered impure with iron and copper.

PLURANIUM, POLINIUM, AND RUTHENIUM.

In 1828 Osann attempted an extended investigation of platinum ores from the Ural Mountains. His researches do not appear to have been characterized by great accuracy, for they resulted in the discovery of three defunct elements—Pluranium, Polinium, and Ruthenium. These elements were of very brief existence, and but little interest is attached to their short career; the derivation of their names, however, has been recorded: Ruthenium from Ruthenia, the ancient name of Russia; Pluranium from the first portions of Platinum and Ural; and Polinium from πολιός, gray.

The element now called Ruthenium was discovered in 1844 by Claus, who showed that Osann's Ruthenium consisted of a mixture of silicic and titanic acids, with alumina, iron oxide, and a small portion of the true metal.

DONIUM.

In 1836 Davidson submitted a mineral, found near Aberdeen, Scotland, to his friend Prof. Thomson for analysis; the latter found the so-called Davidsonite to contain 66% silica, 32% alumina, and 1·3% water, which calculation gives 2½ atoms of silica to one of alumina.

Thomas Richardson, remarking the improbability of this proportion, examined the mineral, and came to the conclusion that it contained, besides alumina, the oxide of a new metal, and he named it Donium, a contraction of Aberdonia, the classical name of Aberdeen. Richardson described a brown and a white oxide, and the metal

itself. Thomson again analyzed the mineral, and showed that Donium oxide was but a mixture of alumina and iron oxide, remarking at the same time an anomaly with reference to the solubility of the earth in ammonia, this being one of the reactions claimed by Richardson as peculiar to Donia.

It appears that neither of these chemists were acquainted with glucina (discovered in 1798), for, some years after, Heddle explained the anomaly by finding this earth in the mineral in question. Dana says Davidsonite is a greenish-yellow beryl.

TREENIUM

Was discovered in 1836, by Boase, in a mineral occurring in decomposed granite at Treene, Land's End. The oxide is described as soluble in potash, and precipitable by chloride of ammonium; it formed an alum, and in this respect resembled alumina. On the other hand, it was soluble in ammonia, and formed two oxides, a white and a brown. Boase thought that it was possibly identical with Richardson's Donium, discovered in the same year.

Further notice of this element, if any exists, has been overlooked.

TERBIUM.

In 1794 Gadolin discovered Yttria in a mineral from Ytterby, Sweden. In 1843 Mosander, another Swede, discovered in Gadolinite two new elements which he called Terbium and Erbium, the names, like Yttrium, being derived from Ytterby—Terbium by dropping the initial "Y," and Erbium by dropping the initial "T" of the last named—a truly original way of christening elements. The existence of Terbium long remained unchallenged, though no method for effecting a perfect separation from Erbium was discovered, a fact which occasioned little suspicion, however, on account of the exceeding difficulty of purifying any of the oxides of this group.

In 1860 Berlin pronounced Terbium to have no existence, and attributed Mosander's errors to the presence of traces of uranium and glucinum.

PELOPIUM.

In 1801 Hatchett discovered Columbium in an American mineral; in the following year Eckeberg discovered Tantalum in a Swedish mineral. Wollaston pronounced these elements identical, and this opinion was generally received until 1846, when Heinrich Rose showed that the American mineral contained the oxides of two metals, both different from that furnished by Tantalite; these he called Niobium and Pelopium, from the children of Tantalus.

These two elements were chiefly distinguished by the reactions of their acids and the nature of their chlorides, that of Niobium being white, volatile, and infusible, while that of Pelopium was yellow, volatile, and fusible. Rose found by subsequent investigation that the two acids were indirectly convertible one into the other, and clearly proved that they contained the same metal, associated with different quantities of oxygen; pelopic acid becoming niobic acid, and niobic acid hyponiobic acid.

Some chemists retain the original name Columbium—and as Americans we have the undoubted right so to do—in which case Niobium becomes one of the defunct elements.

ILMENIUM

Was discovered in 1846 by Hermann. Its history is connected with that of Niobium and Pelopium. H. Rose and Hermann have carried on both the investigation and the controversy, the former contending that ilmenic acid acid was but niobic mixed with tungstic and pelopic;—this Hermann finally admitted.

ARIDIUM

Was discovered by Ullgren in 1850, in chrome iron ore from Röras. As the metal closely resembled iron, he called it Aridium, from ἄρης and εἶδος. Bahr repeated Ullgren's experiments with wholly negative results, since which time nothing has been heard of Aridium.

DONARIUM

Was discovered by Bergemann, in 1851, in Orangite, a mineral containing as high as 71% of the new oxide. Donaria was said to resemble Zirconia, but was of a deep red color; its specific gravity = 5·57. Bergemann described a great many of its compounds, prepared the metal itself, and estimated its atomic weight = 79·71, the oxide having the formula Do_2O_3.

Damour investigated this subject, and remarked that all the properties of Donaria described by Bergemann were common to Berzelius' thorina, except the color and the specific gravity. Finding the specific gravity of the earth extracted from Orangite = 9·36 (that of thorina being 9·4), and attributing the red color to the presence of oxides of lead and uranium, Damour denied the existence of Donaria.

Berlin, who has played the executioner's part with these elements, also maintains the identity of Donarium and Thorinum, and finally Bergemann himself acknowledges this to be probable.

Dana calls Orangite a light-colored variety of Thorite.

THALIUM.

In 1852 Owen discovered, in a magnesian mineral from the northern shores of Lake Superior, an oxide to which he gave the name Thalia. It bore some resemblance to magnesia, but formed green and yellow solutions. Thalit was examined by J. Lawrence Smith and by Genth, who satisfactorily showed that it was a variety of Saponite, and the earth a mixture of magnesia and lime.

DIANUM.

The Bavarian mineralogist Von Kobell, while engaged in analyzing Tantalite from different localities, remarked certain peculiarities in that from Finland, which he attributed to the presence of a new metallic acid, Dianic acid. He distinguished it from niobic and tantalic acids by the formation of a deep sapphire blue solution when treated with tin and hydrochloric acid; Von Kobell afterwards found Dianic acid in Samarskite, Euxenite, and other minerals.

Heinrich Rose examined material sent him by Von Kobell, and attributed the production of a blue color to a trace of tungstic acid. Von Kobell answered with new proofs; St. Clair Deville, Rose, and Hermann separately attacked Von Kobell's views, and to each he replied, thus giving rise to a lengthened discussion upon which it is unnecessary to dwell.

Dianum is now generally classed among the defunct elements.

WASIUM

Was discovered by Bahr, in 1862, in a variety of Allanite, the same mineral which gave rise to Junonium. This mineral (also known as Orthite) contains thirteen

or more oxides, including those of cerium, lanthanium, didymium, yttrium, thorinum, uranium, and tantalum; it is not surprising, therefore, that such a combination of rare earths should occasion errors of this nature.

Delafontaine, and afterwards Bahr himself, concluded that Wasium oxide was but a mixture of thorina and yttria.

(To be continued.)

The Various Methods for the Determination and Separation of Baryta, Strontia, and Lime.

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(Continued from the May Number.)

IV. Separation of Baryta from Strontia.

The methods we have for separating the alkaline earths from each other cannot be counted among the most accurate in analytical chemistry. In fact, several of them are very imperfect, and can only be recommended for such purposes conditionally, as is the case with the three principal methods for separating baryta from strontia. Those three methods are based, as we shall see hereafter, on very few or no analyses at all, and do not bear the close scrutiny of the analyst. The separations are founded on the different deportment of similar and very nearly related salts, and give, therefore, as is always the case under such circumstances, tolerable results when the quantity does not influence the decomposition, that is, when the substances in a solution are nearly in the proportion of the forces of their affinities. This quantity action is well illustrated by almost all the salts of the alkaline earths, and has played a more important part than we generally suppose in the chemistry of geological phenomena.

Separation by means of Carbonate of Ammonia.

This method of acting on the sulphates of the alkaline earths with carbonate of ammonia, and removing the carbonate formed from the remaining sulphate, was first proposed by H. Rose, who, in a very interesting paper (Pogg. Ann., vol. 95, p. 286, 1855), gave his results of an investigation on the differences existing between the alkaline earths in their combination with carbonic and sulphuric acid. All the figures given there are instructive, but the number of separations actually made of the sulphates amounted only to three, and of these only one was made by means of carbonate of ammonia. The conditions under which the analyses were made were the most favorable possible. Other printed records of comparative analyses according to this method, I have not been able to find, and so it seems as though the method rested on this hardly satisfactory basis. The minerals of the alkaline earths contain generally large quantities of the one mixed with very small amounts of the others, which small amounts have to be determined accurately. In the two following analyses the latter case was chosen; chloride of barium and nitrate of strontia, after solution in water, were precipitated completely with dilute sulphuric acid, ammonia then added to alkaline reaction, and the whole digested for thirty-six hours with a sufficient amount of carbonate of ammonia; this had been made by dissolving carbonate of ammonia in cold water. The analyses were finished as described in "Fresenius's Quantitative Analysis," and I will only remark, that the mixed carbonates and sulphates are best washed twice by decantation before bringing them upon the filter. This will prevent their running through, but the last wash-waters are caught advantageously in a clean and empty beaker, in case it should be found necessary, to filter a second time.

1. 2·0680 BaCl (= 2·3174 BaO,SO_3)
   0·2240 SrO,NO_5

Results obtained after weighing.

2·3330 BaO,SO_3		
2·0819 BaCl	=	100·76 p. c.
0·1270 SrO,CO_2		
0·1821 SrO,NO_5	=	81·38 p. c.

2·3330 BaO,SO_3 obtained.
2·3174 " " present.

0·0156 SrO,SO_3 = 0·0180 SrO,NO_5
0·1821 " "

0·2001 " = 89·33 p. c.

2. 0·1885 BaCl
   2·0950 SrO,NO_5 (= 1·4610 SrO,CO_2).

Results obtained after weighing.

——— BaO,SO_3		
1·6330 SrO,CO_2		
2·3416 SrO,NO_5	=	111·77 p. c.

1·6330 S_2O,Co_2 obtained.
1·4610 " " present.

0·1720 BaO,CO_2 = 0.1815 BaCl = 96·29 p. c.

Results calculated to 100.

1.	90·23 BaCl found	90·83	calculated	90·23
	9·77 SrO,NO_5	5.54		8·73
		96·37		98·96
2.	8.25 BaCl found	———	calculated	7·95
	91·75 SrO,NO_5 "	102·55	"	91·75
		102·55		99.70

These two analyses gave quite unsatisfactory results. The great quantity of one constituent of the mixture influenced the other; in one case preventing the total decomposition of the sulphate of strontia, in the other favoring the decomposition of the sulphate of baryta, which outside of the influence of this action would have taken place as in the substances alone. The doubt, however, arose, whether a large amount of sulphate of ammonia had any effect in retarding or preventing the conversion of the sulphate of strontia into carbonate, and whether a concentrated solution of carbonate of ammonia was without effect on sulphate of baryta. To determine this point, pure sulphate of strontia was prepared, and, while yet wet, digested with carbonate of ammonia, to which some caustic ammonia and a very large amount of sulphate of ammonia had been added. After two days' standing the precipitate was filtered off, washed out completely, and treated with hydrochloric acid, wherein it dissolved without leaving any residue. Pure sulphate of baryta was then treated with a concentrated solution of carbonate of ammonia for two days, when it also was washed and treated with hydrochloric acid; this hydrochloric acid solution showed no indications whatever of baryta. If, however, the sulphate of baryta is boiled with carbonate of ammonia, some carbonate of baryta is formed, as has been mentioned already by H. Rose. A very large amount of sulphate of ammonia to little sulphate of strontia will render the action of the carbonate of ammonia rather slow; but a twofold treatment will always convert all sulphate of strontia into carbonate.

Not being satisfied, then, with the above two analyses,

and wishing to determine the margin at which in a mixture perfect decomposition takes place, eight other analyses were undertaken and finished with the greatest care. The carbonate of ammonia acted for about four days on the sulphates, which were stirred up several times, and the analyses completed then in the usual manner with the following results:—

1. 3·0150 BaCl (= 3·3787 BaO,SO_3)
0·1490 SrO,NO_5
obtained 3·4740 BaO,SO_3
3·1001 BaCl = 102·16 p. c.
0·0035 SrO,CO_2
0·0050 SrO,NO_5 = 3·35 p. c.

3·4740
3·3787

0·0953 SrO,SO_3 = 0·1098 SrO,NO_5 = 77·05 p. c.

2. 3·0395 BaCl (= 3·4061 BaO,SO_3)
0·4455 SrO,NO_5
obtained 3·7080 BaO,SO_3
3·3089 BaCl = 108·86 p. c.
0·0305 SrO,CO_2
0·0437 SrO,NO_5 = 9·81 p. c.

3·7080
3·4061

0·3019 SrO,SO_3 = 0·3479 SrO,NO_5 = 78·09 p. c.

3. 2·7435 BaCl (= 3·0744 BaO,SO_3)
1·5235 SrO,NO_5
obtained 3·5390 BaO,SO_3
3·1580 Ba Cl = 115·11 p. c.
0·6695 SrO,CO_2
0·9600 SrO,NO_5 = 63·01 p. c.

3·5390
3·0744

0·4646 SrO,SO_3 = 0·5555 SrO,NO_5 = 35·15 p. c.

4. 2.4765 BaCl (= 2·7752 BaO,SO_3)
2·1845 SrO,NO_5
obtained 3·2770 BaO,SO_3
2·9242 BaCl = 118·07 p. c.
1·0940 SrO,CO_2
1·5687 SrO,NO_5 = 71·37 p. c.

3·2770
2·7752

0·5018 SrO,SO_3 = 0·5784 SrO,NO_5 = 26·48 p. c.

5. 1·6460 BaCl (= 1·8445 BaO,SO_3)
2·6830 SrO,NO_5
obtained 2·1920 BaO,SO_3
1·9560 BaCl = 118·83 p. c.
1·5705 SrO,CO_2
2·2520 SrO,NO_5 = 83·94 p. c.

2·1920
1·8445

0·3475 SrO,SO_3 = 0·4005 SrO,NO_5 = 14·93 p. c.

6. 0·7870 BaCl (0·8819 BaO,SO_3)
2·3790 SrO,NO_5
obtained 0·9740 BaO,SO_3
0·8691 BaCl = 110·43 p. c.
1·5825 SrO,CO_2
2·2691 SrO,NO_5 = 95·38 p. c.

0·9740
0·8819

0·0921 SrO,SO_3 = 0·1061 SrO,NO_5 = 4·46 p. c.

7. 0·4290 BaCl (= 0·4807 BaO,SO_3)
3·0805 SrO,NO_5
obtained 0·5250 BaO,SO_3
0·4685 BaCl = 109·20 p. c.
2·1135 SrO,CO_2
3·0306 SrO,NO_5 = 98·83 p. c.

0·5250
0·4807

0·0243 SrO,SO_3 = 0·0280 SrO,NO_5 = 0·91 p. c.

8. 0·0755 BaCl
3 0125 SrO,NO_5(= 2·1009 SrO,CO_2)
obtained 0·0770 BaO,SO_3
0·0689 BaCl = 90·99 p. c.
2·1100 SrO,CO_2
3·0255 SrO,NO_5 = 100·43 p. c.

2·1100
2·1009

0·0091 BaO,CO_2 = 0·0096 BaCl = 12.71 p. c

It will not be necessary to comment on these analyses. I only may add, that it is difficult to keep the mixed carbonates and sulphates from running through the filter. This was especially noticeable where there was much baryta in a mixture, so that number 8 filtered better than number 7, this better than 6, and so forth down to number 1. The mixtures with much baryta had to be washed longer than the others, as the sulphate of baryta in alkaline solutions retains sulphuric acid. In calculating the results of the foregoing analyses to 100, we obtain the following figures:

1. 95·29 BaCl
4·71 SrO,NO_5

found =	97·98 BaCl calculated	95·29
	0·16 SrO,NO_5	3·63
	98·14	98 92

2. 87·22 BaCl
12·78 SrO,NO_5

found =	94·95 BaCl calculated	87·22
	1·25 SrO,NO_5	11·24
	96·20	98·46

3. 64·30 BaCl
35·70 SrO,NO_5

found =	74·01 Ba Cl calculated	64·30
	22·49 SrO,NO_5	35·05
	96·50	99·35

4. 53·14 Ba Cl
46·86 SrO,NO_5

found =	62·74 Ba Cl calculated	53·14
	33·66 SrO,NO_5	46·06
	96·40	99·20

5. 38·02 Ba Cl
61·98 SrO,NO_5

found	45·19 Ba Cl calculated	38·02
	52 02 SrO,NO_5	61·27
	97·21	99 29

6. 24·86 Ba Cl
75·14 SrO,NO_5

found	27·45 Ba Cl calculated	24·86
	71·67 SrO,NO_5	75·02
	99·12	99·88

7. 12·22 Ba Cl
87·78 SrO,NO_5

found	13·35 Ba Cl calculated	12·22
	86·35 SrO,NO_5	87·15
	99·70	99·37

8. 2·44 Ba Cl
97·56 SrO,NO_5

found =	2·23 Ba Cl calculated	2·54
	97·98 SrO,NO_5	97·56
	100·21	100·10

Not wishing to relinquish this method of separation, I tried to modify it, and thereby obtain perhaps better results. Three more analyses were made, in which, after standing over night, the clear solution was poured through a filter, and the residue digested again with fresh carbonate of ammonia. This was repeated three times, taking altogether three days, before the residue was brought upon the filter and washed; the filtrates were tested each day for sulphuric acid, which proved after the second day to be more in 1 than in 2 and 3, which contained about equal quantities; and after the third day only minute traces were found in all three filtrates. After washing completely, and dissolving the carbonate in hydrochloric acid, number 1 filtered a great deal better than 2 and 3, which in fact had to be filtered twice, before clear solutions could be obtained.

The results were as follows:—

1. 1·8015 Ba Cl (= 2·0188 BaO,SO_3)
0·2840 SrO,NO_5
obtained 2·0810 BaO,SO_3
1·8570 BaCl = 103·08 p. c.
0·1175 SrO,CO_2
0·1685 SrO,NO_5 = 59·33 p. c.

2·0810
2·0188

0·0622 SrO,SO_3 = 0·0717 SrO,NO_5 = 25·25 p. c.

2. 1·5400 BaCl
1·6395 SrO,NO_5(=1·1434 SrO,CO_2)
obtained 1·6030 BaO,SO_3
1·4305 BaCl = 92·89 p. c.
1·2260 SrO,CO_2
1·7579 SrO,NO_5 = 107·22 p. c.

1·2260
1·1434

0·0826 BaO,CO_2 = 0·0872 BaCl = 5·66 p. c.

3. 0·2845 BaCl
1·8500 SrO,NO_5 (= 1·2902 SrO,CO_2)
obtained 0·2370 BaO,SO_3
0·2115 BaCl = 74·34 p. c.
1·3570 SrO,CO_2
1·9458 SrO,NO_5 = 105·18 p. c.

1·3570
1·2902

0·0668 BaO,CO_2 = 0·0705 BaCl = 24.79 p. c.

The results, calculated to 100, are as follows:—

1. 86·38 BaCl
13·62 SrO,NO_5

found	89·04 BaCl calculated	86·38
	8·08 SrO,NO_5	11·52
	97·12	97·90

2. 48·44 BaCl
51·56 SrO,NO_5

found	44·99 BaCl calculated	47·73
	55·29 SrO,NO_5	51·56
	100·28	99·29

3. 13·33 BaCl
86·67 SrO,NO_5

found	9·91 BaCl calculated	13·22
	91·16 SrO,NO_5	86·67
	101·07	99 89

An analysis conducted in this way proves plainly that carbonate of ammonia acts upon sulphate of baryta. We have therefore to distinguish whether in a mixture of baryta and strontia the former or latter predominates; in the first case alone it might be well to digest the mixture twice with carbonate of ammonia, while in the latter case a single digestion would give the best results. The error in all the foregoing analyses will be correspondingly smaller when the results are calculated to caustic baryta and strontia; but this is only a slight satisfaction when for any special purpose exceedingly small amounts of one of them have to be separated from a very large amount of the other.

Adulterated Lard.

The adulteration of lard with water is now so well understood by merchants that the wholesale price is regulated by the nominal percentage of the adulterant. For lard sold as containing eight per cent of water, a deduction of eight per cent from the price of pure lard is allowed, and so on. Unfortunately, however, the buyer, having no ready method for determining the percentage of water, is compelled to accept the statement of the manufacturer; and we are sorry to find that the percentage of water is often understated. A lot of lard sold for exportation as containing eight per cent of water, was found by us to contain sixteen, a difference of eight per cent. This percentage of fraud is probably considerably greater than the shipper's profit. It is said that as much as thirty per cent of water is sometimes present; we have found twenty-one per cent in a sample. It should be remembered that although the fraud is thus partially understood by the dealers, it is not known to the consumer, who buys lard containing often one-fourth its weight of water for pure lard.

The presence of water is very easily detected by merely melting the lard, when the water collects at the bottom of the vessel as a distinct layer.

To determine the exact percentage of water we weigh out 100 grammes of the sample, melt it in a beaker placed in hot water, and when melted pour it into a cylinder graduated in cubic centimetres. It is advantageous to place the cylinder in hot water for a few minutes, till the separation of water and lard is

complete. The percentage of water is then read off on the scale.

This test may be made by any person of ordinary intelligence. It thus appears that oil and water can be made to mix, provided there is a pecuniary advantage in the operation.

Combining Power of Phosphoric Acid.

CAMBRIDGE, June 1st, 1870.

DEAR CHANDLER:—

IN the course of my researches upon phosphoric acid, I have arrived at certain results which have a scientific interest that I am sure you will appreciate. Among other things, I produced, sixteen years ago, compounds, dry, non-hydroscopic, and crystalline, in which the number of atoms of lime to phosphoric acid was in the ratio of $5CaO$ to $6PO_5$. In the interval since then I have made numerous other compounds of lime and phosphoric acid, in which the ratio of acid was still higher. About a year since I obtained a compound, dry, crystalline, and non-hydroscopic, in which there was but one atom of lime to three of phosphoric acid. Since then I have succeeded in obtaining a dry nonhydroscopic phosphoric acid, containing this acid and water only; and my friend Dr. Genth, in following my directions, has repeatedly obtained in beautiful crystals the compound PO_5+5HO, with only a trace of impurity.

I have found that when phosphoric acid solution, under certain well-defined conditions, is concentrated till the solution contains twenty-four atoms of water to one of acid, and then mixed with one and one-half atoms of starch ($C_{12}H_{10}O_{10}$), a thoroughly dry, nonhydroscopic powder is obtained on drying, in which fourteen of the twenty-four atoms of water are replaced by starch. On the other hand I have repeated Miller's experiments, made to determine whether phosphoric acid would combine with more than three atoms of lime to one of acid. Miller employed saccharate of lime, and obtained an excess of lime over three atoms, which Erlenmeyer suggested might be due to hydrate of lime. I find, however, that when hydrated tribasic phosphate of lime is boiled with lime-water, it takes up lime in excess of four atoms of lime to one of acid; and the powder contains water of crystallization, and does not indicate with test paper the slightest alkaline reaction.

Pure precipitated $3CaO,PO_5+Aq$ after being dried, gives, on the addition of water, an acid reaction, although precipitated in the presence of a large excess of ammonia, and shown by analysis to contain $3CaO$ to $1PO_5$.

It was my fortune, I believe, to be the first who made a *dry non-hydroscopic*, monocalcic orthophosphate (biphosphate of lime).

I may sum up the above in the following formulæ, as exhibiting my results:—

$$CaO,2HO,PO_5+Aq$$
$$5CaO,6PO_5+Aq$$
$$5CaO,8PO_5+Aq$$
$$5CaO,12PO_5+Aq$$
$$CaO,3PO_5+Aq$$
$$PO_5+Aq$$
$$4CaO,PO_5+Aq$$

all of these compounds being obtained in a dry, nonhydroscopic form. At no distant period I hope to have the pleasure of submitting a paper containing the numerical data on which the above calculations rest, together with other matters connected with this most interesting acid. I am, faithfully yours,

E. N. HORSFORD.

Blowpipe Attachment to Bunsen's Filtering Water Air-Pump.

GEORGE W. RAINS, M.D., Professor of Chemistry at the Medical College of Georgia, sends us a drawing of a blowpipe attachment to the water air-pump which we should be glad to present did our space permit. It is designed to supply a blowpipe with the air which is impelled by the water current. The attachment is connected with the fall-pipe of the Bunsen's filtering apparatus, and the stream of air and water is forced to enter it by the closing of a cock situated below the point of attachment. The apparatus consists of an open vessel, in which is placed a smaller vessel closed at the top, but provided with three openings: two on the top, one for the entrance of the air and water, the other for the exit of the air to supply the blowpipe. The third opening is on the side near the bottom, for the escape of the water. As the water fills the outer vessel and flows over its rim, the air in the inner reservoir is subjected to the pressure of a column of water equivalent to the depth of the outer vessel.

The contrivance is very simple, and will furnish a continuous jet of air for the blowpipe, or for any other object.

The Geyser Spring at Saratoga, N. Y.

THE Spouting Spring or Geyser was obtained last winter by boring. At a depth of 160 feet, a crevice was penetrated from which the water has continued to issue ever since. Four or five times a minute the jets shoot up, striking the ceiling of the room of Vale & Seavey's bolt factory, in which the boring was made. The spring is located a mile and a half south of the village of Saratoga Springs, on the Ballston road. An analysis of the water made by the editor, with the aid of Mr. F. A. Cairns, gave the following results:—

Chloride of Sodium	562·080	grains.
Chloride of Potassium	24·634	"
Bromide of Sodium	2·212	"
Iodide of Sodium	0·248	"
Fluoride of Calcium	trace	
Bicarbonate of Lithia	7·004	"
Bicarbonate of Soda	71·232	"
Bicarbonate of Magnesia	149·343	"
Bicarbonate of Lime	170·392	"
Bicarbonate of Strontia	0·425	"
Bicarbonate of Baryta	2·014	"
Bicarbonate of Iron	0·979	"
Sulphate of Potassa	0·318	"
Phosphate of Soda	trace	
Biborate of Soda	trace	
Alumina	trace	
Silica	0·665	"
Organic matter	trace	
Total solid contents	991·546	"
Carbonic Acid Gas in 1 U. S. Gal.	454·082	cub. in.
Density	1·011	
Temperature	46°	Fah.

Recent Chemical Patents.

Issued April 19, 1870.

101,969.—Manufacture of Steel from Cast or Pig Iron.—H. M. Baker, Washington, D. C.

102,018.—Apparatus for Removing Oils, Grease, Gums, and the Like from Cotton and Woollen Waste, and Recovering the Same.—J. W. Kupps, Chicago, Ill.

102,030.—Method of Treating Tracing Paper.—Julius Moog, Karlsruhe, Germany.

102,135.—Treating Paraffine and obtaining it in Crystals.—Frederick Lambe, London, England.

102,146.—Manufacture of Steel.—Charles Motier Nes, York, Pa.
102,148.—Treating Tin Scrap to obtain Useful Products.—D. D. Parmelee, N. Y. City.
102,198.—Bronzing and Gilding.—J. L. Duffee, Washington, D. C.

Issued April 26, 1870.

102,203.—Apparatus for Mixing Hydrogen and Air.—Daniel Ash, Wappingers Falls, N. Y.
102,205.—Concentrating Oil of Vitriol.—W. H. Balmain, St. Helen, Great Britain.
102,239.—Apparatus for Separating Wood Fibre for Paper, etc.—Albert Fickett, Rochester, N. Y.
102,265.—Manufacture of Paper.—Isaac Hoffman, Oregon, N. Y.
102,268.—Manufacture of India-Rubber Belt.—Albert H. Hook, N. Y. City.
102,324.—Manufacture of Alloys of Manganese.—Elliot Savage, West Meriden, Conn.
102,378.—Coating and Bronzing Iron.—Lansing Dockstader, West Meriden, Conn.
102,387.—Manufacture of Yeast.—Henry Fleishmann, N. Y. City.
102,438.—Manufacture of Fertilizers.—W. J. Sapp, Baltimore, Md.
102,450.—Preventing Mildew and Decay in Sails, Awnings, Tents, Tarpaulins, and other Articles and Fabrics.—W. A. Torrey, Mount Clair, N. J.

Issued May 3, 1870.

102,546.—Manufacture of Soap.—Charles Wager Hull, N. Y. City.
102,550.—Process for Tempering Steel.—Jabez Jenkins, Philadelphia, Pa.
102,570.—Compound for Dressing Textile Fabrics.—John McGill, Boston, Mass.
102,633.—Evaporating and Distilling by Solar Heat.—Norman W. Wheeler, Brooklyn, L. I.
102,648.—Drying Guano.—Edwin P. Baugh, Philadelphia, Pa.
102,689.—Manufacture of Fertilizer and Oil from Fish.—Orazie Lugo, Baltimore, Md.
102,715.—Compound for Refining Cider, Wine, &c.—Oliver Schaffer, Dayton, Ohio.
102,740.—Manufacture of Wrought Iron from Ore, Cinder, or Slag.—James D. Whelpley and Jacob J. Storer, Boston, Mass.

Issued May 10, 1870.

102,748.—Electro Deposition of Nickel.—Isaac Adams, Jr., Boston, Mass.
102,760.—Bleaching, Tanning, and Coloring Sponges.—Frederick Braun and A. T. Schmidt, Pittsburgh, Pa.
102,774.—Distilling Turpentine.—David Cashwell, Wilmington, N. C.
102,799.—Manufacture of Steel.—William Fields, Wilmington, Del.
102,797.—Manufacture of Iron.—William Fields, Wilmington, Del.
102,819.—Apparatus for Distilling Hydrocarbon Oils.—S. A. Hill and C. F. Thumm, Oil City, Pa.
102,824.—Acid and Water-proof Composition for Coating Cloth, &c.—H. W. Johns, N. Y. City.
102,832.—Apparatus for obtaining Tanning Extracts.—Simon H. Kennedy, N. Y. City.
102,868.—Bleaching Straw Goods.—A. M. Rosbrugh, Panora, Iowa.
102,869.—Preserving and Hardening Stone, Brick, &c.—E. J. Saliabury, San Francisco, Cal.
102,936.—Manufacture of Soap.—H. M. Baker, Washington, D. C.
102,912.—Manufacture of Iron and Steel.—J. P. Budd, Ystalyfera, near Swansea, Wales.
102,960.—Reworking Bessemer Steel.—Charles Motier Nes, York, Pa.
102,969.—Manufacture of Sugar.—Juan Poey, Havana, Cuba.
102,936.—Apparatus and Process for Refrigerating, Preserving, and Ventilating.—D. E. Somes, Washington, D. C.

Reissues.

3,021.—Treating Organic Materials with Air.—Rudolph D'Heureuse, N. Y. City.
3,959.—Manufacture of Yeast for Distillers.—Joseph Wolff, Cincinnati, Ohio.
3,952.—Bronzing and Gilding.—John L. Duffee, Washington, D. C.

Extensions.

Pulverulent Acid for Use in the Preparation of Soda Powders Farinaceous Food, and other Purposes.—E. N. Horsford, Cambridge, Mass.

NEW PUBLICATIONS.

Report of Prof. W. E. Aikin, Inspector of Illuminating Gas for the City of Baltimore, on the Comparative Value of Different Gas-burners. May 9, 1870.

This report embodies the results of the careful examination of eighty-two burners, of which thirty-six were *union jet* burners, thirty-seven *bat-wing* burners, and seven *argands*. We regret that an additional column, showing the candle-powers for the same consumption of gas, or the consumption for the same candle-power, was not added to the otherwise very complete record of the experiments. We hope to be able to print the report in full in our next issue.

BREVITIES.

The Lyceum of Natural History.—At the meeting of the Chemical Section, held May 9th, the following papers were read:—

Prof. Charles A. Seely: On the Constitution of Ammonium Amalgam.
Dr. Isidor Walz: Laboratory Notes.

May 16th.

Dr. H. C. Bolton: On the Rise and Fall of Defunct Elements.
Mr. F. Prime, Jr.: On the Metallurgy of Argentiferous Galena.
Prof. J. S. Newberry: On the Ancient Lakes of Western North America, their Deposits and Drainage.

Naphthaline, which occurs in large quantities in the waste of gas-works, and has always been rejected as worthless, is found by Prof. Asa Gray to be an admirable substitute for camphor, as a protection against moths and other insects.

Prof. Frederic Stengel has been elected teacher of German, and Prof. J. E. Loiseau, teacher of French, in the Columbia College School of Mines.

Salt at Alpena.—We have seen a specimen of the salt taken out of the well at Alpena, with the sand pump, at a depth of about 1,100 feet, which is, to all intents and purposes—save bearing a tinge of the rocky sediment worked off the walls of the well, which gives it a bluish color—pure salt; remarkably free from the pungent taste which the chlorides impart to the brine as at first found in many localities, purely and essentially rock salt. Of the importance of this discovery, in view of the fact that it costs the mills at Alpena thousands of dollars annually to burn up their sawdust, slabs, edgings, and debris, and that the port of Alpena is only fifteen miles off the regular course of Chicago bound vessels, we have before this had something to say; and it being thus settled that Alpena is to become an important salt-producing locality, will have much to do, as well with the prosperity of that thriving locality as with the general business of manufacturing salt in the Saginaw Valley and on "the Shore."

ANSWERS TO CORRESPONDENTS.

Adulterations of Sugar and Molasses.—We reply to *A Subscriber* that acetate of lead is not, to our knowledge, ever used in sugar refining. The basic acetate of lead is universally used in the laboratory for testing sugar in connection with the polariscope. Its use in refining was proposed in England by Scoffern, but was never accepted on account of the danger of leaving it in the sugars or syrups. Ultramarine is used universally in England, France, Germany and America, and is entirely harmless. Grape sugar is used on the continent for extending the syrups, and is in no way objectionable. The other agent you mention has been used in this country by a few refiners, so far as we know, in quantities so small as to be unobjectionable.—Editor.

Dental Vulcanite and Iodized Rubber.—These preparations for plates for artificial teeth differ materially. *Dental Vulcanite* is composed of India-rubber, sulphur and vermillion, and when baked owes its hardness to the action of the sulphur. Its manufacture is covered by the Goodyear Hard Rubber Patent. *Iodized Rubber* is prepared under the patents of Newbrough and Fagan. It is a mixture of India-rubber, iodine, and vermillion, containing generally kaolin or some other inert substance, and a small quantity of sulphur. When oxide of iron is used as a coloring agent in place of vermillion, no sulphur is added. The hardening of this compound is due to the action of the iodine on the rubber. The iodized rubber has been the subject of an interesting lawsuit, on the ground that its manufacture was an infringement of the Goodyear Hard Rubber Patent. As the plaintiffs compromised the suit, it seems that they accepted the testimony of the defendants' chemists, who claimed that the hardening was due to the iodine.

Bartlett's White Lead.—This pigment differs entirely from ordinary white lead, which is a carbonate of lead. It is a very intimate mixture of oxide of zinc and sulphate of lead, which is produced from an ore found at the Stewart Mine, near Charlotte, North Carolina. The ore is a compact mixture of zinc blende and galena. It is roasted at the mine, shipped to Bergen Point near New York, and there reduced in peculiar furnaces. The roasting changes ZnS to ZnO, and PbS to $PbO.SO_3$. The reduction changes ZnO to Zn, and $PbO.SO_3$ to PbS. These products rise in vapor and are oxidized by a current of air to ZnO and $PbO.SO_3$, which are collected in a system of cotton bags, and constitute the *Bartlett White Lead.*

It is an interesting fact that the roasted ore yields to water a quantity of sulphate of cadmium: this may become a very important source of this somewhat rare metal.

The following analysis of Bartlett White Lead was made by Prof. C. P. Williams, and published in the Journal of the Franklin Institute for March, 1869.

Oxide of Zinc	72·083
Oxide of Iron	trace.
Ox de of Antimony	trace.
Oxide of Lead	0·274
Sulphate of Lead	23·068
Sulphate of Zinc	0·810
Chloride of Zinc	0·839
Chloride of Iron	0·071
Terchloride of Antimony	trace.
Chloride of Cadmium	0·256
Moisture	0·398
	98·699

QUESTIONS FROM CORRESPONDENTS.

Nitro-Glycerine.—What is the explosive power of Nitro-glycerine as compared with gun-powder? *Engineer.*

Lead in Potable Water.—I have had some difficulty in the quantitative estimation of small quantities of lead in city water. What is the best method for accurate estimation? *W. T. S*

Potash from Feldspar.—Why has not the manufacture of potash from feldspar been prosecuted? What are the obstacles to its success? *Engineer.*

Glove Stains.—Will some one tell me an easy method of removing mildew spots from kid gloves? *A. B.*

STORAGE